

VOLUME 2 OF 6
TECHNICAL SPECIFICATIONS DIVISION 1 - 10

CITY OF AUMSVILLE

**Project Manual:
SPECIFICATIONS AND CONTRACT DOCUMENTS**

For

**AUMSVILLE WASTEWATER TREATMENT PLANT
IMPROVEMENTS**



JO 2599.3220.0

May 2026

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**THE CITY OF AUMSVILLE
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See drawing Sheet G002 for sheet index of construction drawings.

DIVISION 1

GENERAL REQUIREMENTS

SECTION 01024
SCHEDULE OF VALUES

(To be submitted after bid opening and contract award)

PART 1: GENERAL

1.1 SCOPE

- a. Work under this section includes preparation and submittal of schedule of values documentation as specified below.

1.2 DESCRIPTION

- a. Submit to the Owner's Representative a schedule of values allocated to the various portions of the work within 10 days after the effective date of the Agreement.
- b. Upon request from the Owner's Representative, support the values with data which will substantiate their correctness.
- c. The schedule of values, unless objected to by the Owner's Representative, shall be used only as the basis for the Contractor's Application for Payment for lump sum bid items or change order pricing as applicable.

1.3 FORM AND CONTENT OF SCHEDULE OF VALUES

- a. Form & Format:
 - 1) SOV to be typed on 8-1/2" x 11" white paper.
 - 2) The schedule of values shall conform with the following.
 - a) Subject to the requirements below, Contractor's standard forms and automated printout may be used.
 - b) Identify schedule with:
 - (1) Title of project and location
 - (2) Owner's Representative
 - (3) Project number
 - (4) Name and address of Contractor
 - (5) Contract designation
 - (6) Date of submission
 - c) Follow the table of contents of this project manual as the format for listing component items.
 - d) Identify each line item with the number and title of the respective major section of the Specifications.
 - e) Sub-values: For each major line item, list sub-values of major products or operations under the item.

- f) Materials on Hand. For items on which progress payments will be requested for stored materials, break down the value into:
 - (1) The cost of the materials, paid for, delivered and unloaded, with taxes paid.
 - (2) The total installed value.
- b. For the various portions of the work, each item shall include a directly proportional amount of the Contractor's overhead and profit.
- c. The sum of all values listed in the schedule shall equal the total contract sum.
- d. The schedule of values is subject to review and approval by the Engineer and Owner's Representative.

PART 2: PRODUCTS

None.

SECTION 01025
MEASUREMENT AND PAYMENT

PART 1: GENERAL

1.1 MEASUREMENT AND PAYMENT AND DESCRIPTION OF BID ITEMS

a. Partial payment of bid items shall be in conformance with the General Conditions. Partial payment for work completed, and materials on site, which will become an integral part of the finished work, shall be determined by the Owner and shall be made on the basis of duly certified and approved estimates of the work, which, in the opinion of the Owner, has been satisfactorily completed. It is understood that the determination by the Owner as to whether or not a certificate or estimate for payment should be issued, or the amount of said payment, shall be based entirely upon the opinion of the Owner. Said determination shall include without limitation the following factors:

b. All phases of the work being accomplished in a proper manner and being pursued in a proper sequence of operation, particularly with regard to testing, clean-up and surface restoration.

- 1) The observance by the Contractor of the requirement that all work and operations be preceded by necessary submittals and approvals.
- 2) On the monthly estimates, partial payments for work performed but not completed, may be made in accordance with the following schedule, except as otherwise noted in the specifications:

Cost of material delivered to the site.	95% of the invoice cost of the material.
Materials installed backfilled and compacted, prior to testing.	80% of unit price for material in place.
Clean-up and surface restoration completed.	95% of unit price.
Testing and Startup Completed	100% of unit price upon satisfactory completion.

- 3) Retainage will be deducted from the above amounts as specified in the Contract Agreement.
- 4) The contract price shall constitute full compensation for furnishing all plant, labor, equipment and materials, and performing all operations required to complete the work, as specified, and as shown on the drawings, or as otherwise directed.

c. See Section 01024 for the schedule of values submittal required to facilitate partial payments.

1.2 BID ITEMS

a. Lump Sum Bid Schedule Items

- 1) Lump Sum Bid Item 1 – Lump Sum Bid Price for the Wastewater Treatment Plant Improvements.

The lump sum price shall constitute full compensation for construction of the Aumsville Wastewater Treatment Plant Improvements including: mobilization, demobilization, bonds, permits, insurance, construction staking, clearing and grubbing, stripping, erosion control, traffic control, earthwork, materials testing and inspection, grading, paving, rock, landscaping, testing and startup assistance, electrical, controls, mechanical, structural, and piping work for installation of the influent forcemain, headworks, sequencing batch reactor, equalization basin, chlorine contact chamber, blower building, dissolved air floatation building, storage building, effluent pump station, DAF pump station, plant pump station, all chemical feed equipment, all modifications to the existing lagoons including the new control structures and the modifications to the existing lagoon control structures, and associated above and below ground pipelines, and all associated improvements shown and specified in the Contract Documents. Not included in this item are the items associated with the Unit Price Bid Schedule. Included in the price is all incidental work not included in any other bid item.

- 2) Lump Sum Bid Item 2 – Assigned Contract for the Sequencing Batch Reactor Equipment Procurement Contractor (Remaining Balance Due)

The lump sum price shall constitute the full compensation for the remaining balance due to the supplier for the equipment procurement. This price shall be included in the Schedule of Values. All costs for the Contractor's mobilization/demobilization, labor, materials, equipment, overhead, and profit, for the complete installation, startup, and testing of the equipment shall be included in Bid Item 1 above.

- 3) Lump Sum Bid Item 3 – Assigned Contract for the Dissolved Air Floatation Equipment Procurement Contractor (Remaining Balance Due)

The lump sum price shall constitute the full compensation for the remaining balance due to the supplier for the equipment procurement. This price shall be included in the Schedule of Values. All costs for the Contractor's mobilization/demobilization, labor, materials, equipment, overhead, and profit for the complete installation, startup, and testing of the equipment shall be included in Bid Item 1 above.

- 4) Lump Sum Bid Item 4 – As-Built Drawings, Complete -Stipulated Price.

This is a stipulated price for the as-built drawings that will be paid only when approved as-built drawings have been delivered to the Engineer by the Contractor. This stipulated price shall be included in the Schedule of Values.

5) Bid Item 1.d. – O&M Manuals, Complete - Lump Sum Stipulated Price.

This is a stipulated price for the O&M Manuals that will be paid only when approved manuals have been delivered to the Engineer by the Contractor. See section 01705 for additional information. This stipulated price shall be included in the Schedule of Values.

b. Allowances

1) Lump Sum Cash Allowance 1: Power Company Connection Fees – Allowance.

This is an allowance item from which the Contractor will only be paid for the amount authorized during the project to pay Pacific Power for the new the power service installation work to serve the new WWTP. No payment will be made for unauthorized expenditures of this allowance. A fee less than or more than the allowance amount shall be adjusted by change order. The payment allowance will be for the actual fees charged by Pacific Power. No adjustments to Pacific Power's fees will be made. The Contractor shall include any overhead or mark up and mobilization/demobilization costs in the lump sum bid item 1. This item does not include those components of the power system that are to be furnished and installed by the contractor. Costs for the Contractor's portion of the power service installation costs (i.e., conduit installation, trenching, backfill, vaults, pedestals, etc.) shall be included the lump sum bid item 1. Any requests from the Contractor for payment under this allowance shall be accompanied by invoices from the Power Company and the amount requested shall match the invoice amounts.

c. Unit Price Bid Schedule Work

1) Unit Price Bid Item 1 – Trench Foundation Stabilization.

Foundation stabilization, when authorized in writing by the Engineer, to be paid for on a cubic yard basis at the stipulated prices named in the Bid Form, based on the design depth of the trench to the invert of the pipe. Length and width will be measured horizontally along foundation stabilization material actually installed. Payment to include all costs for material removed and disposed of offsite, and backfill material placed as specified. These prices shall apply whether such overexcavation consists of multiple isolated segments or the entire trenchline. No payment will be made for unauthorized trench foundation stabilization.

2) Unit Price Bid Item 2 – General Site Overexcavation and Backfill.

General Site overexcavation and backfill below the bottom of the subgrade elevations shown, noted, or described on the drawings or in the specifications to rectify soft and uncompactable native subgrade, will be paid at a stipulated price for each cubic yard of material removed (*in-place volume*) and disposed of off site, and geotextile fabric and additional thickness of granular baserock material placed as specified. Payment for overexcavation will only be made when authorized in writing by the Engineer. No payment will be made for unauthorized overexcavation

and backfill. No additional payment will be made for subgrade over-excavation or repair work that is the result of the contractors excavation techniques. Excavations to final subgrade elevations shall be made using a smooth edge bucket in a manner that does not disturb the native subgrade as described in Section 02201 and the Geotechnical Report.

Volume shall be based on the length, width & depth measured along the over-excavation area and the granular baserock foundation stabilization material actually installed. These prices shall apply whether the over-excavation consists of small isolated areas, large areas or the entire street, parking lot, building pad or other areas.

SECTION 01040
MOBILIZATION, BONDS, PERMITS AND INSURANCE

PART 1: GENERAL

1.1 SCOPE

- a. This section includes but is not limited to work necessary to move in personnel and equipment, set up all offices and facilities and prepare for construction and provide necessary permits, licenses, construction bonds and required insurance, and to locate, reference, protect and/or replace existing property, survey monuments and markers, and demobilization once the project is complete.

1.2 CONSTRUCTION SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include, but not be limited to, the following:
 - 1) Submittals for Record
 - a) Copies of all construction permits and licenses required by all approving agencies, including as applicable cities, counties, state agencies, utility service districts, etc.
 - b) Copies of all building, electrical, mechanical, and plumbing permits (as appropriate) required by all agencies with jurisdiction.

PART 2: PRODUCTS

None.

PART 3: EXECUTION

3.1 GENERAL

- a. Set up construction facilities in a neat and orderly manner within designated or approved work area. Supply all labor and equipment necessary to accomplish the work as specified. Conform to applicable requirements of these Contract Documents, including but not limited to:
 - 1) Required notifications
 - 2) Protection of construction survey stakes, hubs and other markers
 - 3) Protection of survey monuments of record, including but not limited to property and street monuments
 - 4) Temporary utility connections
 - 5) Protection of property
 - 6) Dust control
- b. Move personnel, equipment, supplies and incidentals to the project site. Establish offices, buildings and other facilities necessary for work required.
- c. Contractor to conform to all permit requirements, including providing forty-eight (48) hours

notice to approving agencies, and all utilities prior to the start of construction.

- d. The Contractor shall serve all necessary notices incidental to the due and lawful prosecution of the work.
- e. Project Signs. When the agencies with an interest in the project require the posting of signs for public notification, the Contractor shall construct and post such signs in conformance with the requirements of the respective agencies. The Contractor shall be responsible for supplying the materials necessary to post the signs and notifications, including posts, plywood backing and sign painting and/or placards. Unless otherwise required by respective agencies, project sign(s) must be mounted within 15 days of Notice to Proceed.

3.2 PERMITS, BONDS & INSURANCE

- a. Contractor shall provide all payment and/or performance bonds and insurance certificates required by public and/or private agencies having jurisdiction prior to issuance of the Notice to Proceed where specified, or prior to commencement of any work under said permits otherwise.
- b. Owner to pay all project permit costs. The contractor shall coordinate with the governing jurisdiction to determine appropriate fees and provide the Owner with 48 hours notice prior to the required payment of fees or costs.
- c. The Contractor shall procure all building, electrical, mechanical, and/or plumbing permits (as appropriate) required by all approving agencies, as well as being responsible for all costs associated with Contractor coordinating all inspections required for such permits. The Contractor shall coordinate for any and all special inspections required for such permits.

Payment for costs & fees associated with such building, electrical, mechanical, and/or plumbing permits shall be as summarized under Section 01025.

PART 4: SPECIAL PROVISIONS

None.

SECTION 01042
CONSTRUCTION SEQUENCING

PART 1: GENERAL

1.1 SCOPE

- a. This section includes construction sequencing and provision of temporary facilities necessary to maintain all existing facilities during the performance of this work unless otherwise specified.

1.2 REQUIREMENTS

- a. The Contractor shall construct the project so as to minimize disruption to existing facilities. One week advance notice shall be given to the Owner's Representative, police, fire, transit, school district, ODOT, and Marion County prior to beginning work on any facility which requires disruption of normal operation.
- b. Contractor to provide for the flow of sewers, drains, or watercourses during the course of the work. All existing facilities to be restored to the satisfaction of the Owner's Representative.
- c. Make excavations and borings ahead of work, as necessary, to determine the exact location of interfering utilities or underground structures.
- d. Contractor to coordinate with other trades for completion of the work in a timely manner.
- e. When any unit is removed from service, all associated modifications shall be performed. The work shall be performed in such a manner as to avoid removing a unit from service more than once.
- f. Maintain a treatment efficiency not less than efficiency achieved during the corresponding month of the previous year. All facilities must be kept in effective operation at all times.
- g. Sewer Pump Stations. Maintain pumping capacity in all existing pump stations and force mains until new pump stations and pipelines are complete, accepted by the Owner and placed into permanent service. Where connections are made to existing influent sewers or force mains in conjunction with the new pump station(s), contractor shall provide temporary facilities as required to maintain flows into and out of existing facilities as required to maintain service. All facilities must be kept in effective operation at all times, except where specific prior written approval is granted by the Owner or Owner's Representative.

1.3 TEMPORARY CONSTRUCTION

- a. The Contractor shall furnish and install all necessary temporary construction required to maintain the operation of the facility, including bulkheads, plugs, stop planks, stop plates, blind flanges, pipelines, pipe connections, flumes, cofferdams, pumping equipment, valves, etc.
- b. All costs including labor, equipment and materials that are required shall be paid by the Contractor.

- c. All temporary facilities shall be of the Contractor's design, subject to approval by the Owner's Representative and operations personnel.
- d. All phases of work requiring interference of normal operation of the existing facility shall be scheduled in accordance with agreements made on the job between the Contractor, Owner and Owner's Representative. The Contractor shall notify the Owner at least one week before such work is to begin.

1.4 SEQUENCING OF CONSTRUCTION PHASES

- a. The Contractor shall be required to follow all construction sequencing required by this section and as noted on the drawings, and coordinate the timing of all work with the Owner's Representative, property owners, private utilities, and public agencies.
- b. Substantial & Final Completion. In addition to the standard definitions & requirements in the General Conditions & Contract Documents, substantial & final completion of each phase shall be subject to the following. Any variances from these requirements must be approved in writing by the Owner's Representative prior to commencement of work in a subsequent phase.
 - 1) Surface Restoration. All paved and gravel surface final restoration (*both within public right-of-ways and on private property*) for a phase must be complete in order for the phase to be considered substantially complete. All other surface restoration within the phase, including but not limited to seeding/mulching of unimproved areas, landscaping, final fence restoration, etc. must be entirely completed within the time period specified for final completion for that phase.
 - 2) Waterline Improvements. In addition to complete construction of all pipelines & appurtenances as specified or shown on the drawings, the following specific requirements relate to substantial & final completion of each phase.
 - a) Pressure testing of all pipelines, valves, fire hydrants & appurtenances within phase boundaries prior to substantial completion of each phase, with the following exception.
 - b) Flush and disinfect pipelines, valves, fire hydrants & appurtenances within the time period specified for substantial completion.
 - c) Bacteriological testing must be completed within the time period specified for final completion. Failure of a test and the need to re-chlorinate will not entitle the Contractor to additional Contract Time.
 - 3) Gravity Sanitary Sewer Improvements. In addition to complete construction of all pipelines & appurtenances as specified or shown on the drawings, the following specific requirements relate to substantial & final completion of each phase.
 - a) Air & mandrel testing of all pipelines & appurtenances within phase boundaries, as well as correction of any problems revealed, prior to substantial completion of each phase.
 - b) TV inspection of all pipelines & appurtenances within phase boundaries, as well as correction of any problems revealed, prior to substantial completion of each phase.

- c) Vacuum Testing of all manholes within phase boundaries must be entirely completed within the time period specified for final completion for each phase.

PART 2: PRODUCTS

None

PART 3: EXECUTION

None

PART 4: SPECIAL PROVISIONS

None.

SECTION 01043
COORDINATION AND CONTROL OF THE WORK

PART 1: GENERAL

1.1 SCOPE

- a. This section includes coordination and control of the work.

PART 2: PRODUCTS

None.

PART 3: EXECUTION

3.1 GENERAL

- a. Specification Language. Portions of the Specifications may be written in imperative and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” or “shall conform with” shall be included by inference where a colon (:) is used within sentences or phrases. Example – Aggregate: ASTM C33.
- b. The Contract Documents are complementary and what is called out by any portion of the Contract Documents (drawings, specifications, or contract forms) shall be as binding as if called for by all.

3.2 TIMEFRAME FOR CONTRACTOR SUBMITTAL OF PRICE & COST PROPOSAL

- a. When the Owner’s Representative requests that the Contractor prepare a proposal for cost and/or times required to perform changes in the work (*contemplated or directed changes*), the Contractor shall provide a written proposal (*cost and/or time*) to the Owner’s Representative within 7 days of such written request (*GC 10.01.B & SC 10.01.B.1&2*).

3.3 UTILITY LOCATE & POTHOLING REQUIREMENTS

- a. Utility Locate Requirements. ATTENTION: Oregon law requires you to follow rules adopted by the Oregon Utility Notification Center. Those rules are set forth in OAR 952-001-0001 through OAR 952-001-0100. You may obtain copies of the rules by calling the center. (Note: the telephone number for the Oregon Utility Notification Center is 503-232-1987 or 811). These requirements include, but are not limited to, responsibility for pre-marking by excavator, responsibility for notice to Oregon Utility Notification Center by excavator, responsibility of contractor to wait the specified time before starting excavation, responsibility of excavator to maintain marks during the excavation period to ensure that the original marks remain effective for the life of the project or the locate ticket life (ticket life as defined under OAR 952-001-0010), whichever is the shorter period.
- b. Potholing Requirements. Contractor shall field verify location and depth of all existing utilities where new utilities or facilities cross or are closely parallel to the existing utilities (or which are otherwise in close proximity to new utilities). All existing utilities which

are either (A) marked in the field or (B) which are shown on the drawings, shall be potholed using hand tools or other non-invasive methods prior to excavating or boring to determine the exact location and depth of the existing utility (see OAR 952-001-0090 for State required potholing limits & depths). Persistent failure (as determined by the Owner's Representative) to follow these drawing requirements & State rules regarding exposing & determining the exact location and depth of existing utilities shall be grounds for suspension or cancellation of the permit, or termination of the contract (at the sole discretion of the Owner's Representative).

3.4 NOTICE TO PROPERTY OWNERS/POLICE/FIRE/POST OFFICE/GARBAGE/RECYCLE, CONTRACTOR RESPONSIBILITY

- a. When work performed by Contractor will impact or interrupt water/sewer/storm drainage utility service or interrupt vehicular or pedestrian access to any public or private property, Contractor shall notify all the affected parties one week prior to and again 24-48 hours prior to the anticipated impact or interruption in service (Contractor is responsible to coordinate with the City staff a minimum of 1 week prior in order to verify area of impact or interruption).
- b. Contractor shall provide written notice (door hangers or equivalent) a minimum of 24 hours (and a maximum of 48 hours) before beginning operations of which will interfere with or interrupt water/sewer/storm drainage utility service (or interrupt vehicular or pedestrian access) to all residences, structures or businesses impacted by the work.
- c. The written notice shall specify the day, date, approximate time (ie. morning or afternoon) when the work will commence, and anticipated duration of the work, and shall include the name and cell number for the designated contact person with the Contractor.
- d. In addition to the written notice, a representative of the Contractor shall knock on the front door of all affected residences or businesses on the morning that the work will commence, and attempt to notify the residents or businesses that this work will commence that day. The Contractor shall document in writing the date and approximate time that this attempt was made for the residences or businesses for each segment of the work.
- e. Written notice shall also be provided to the City Public Works based on the same schedule, and shall include a photocopy of door hangers used.
- f. If work is interrupted or stopped for 7 calendar days or more, new notice shall be provided to all affected parties again prior to resuming work.
- g. If failure by the Contractor to provide timely notice as specified above results in delays to the ability to make the connections or perform the work for which such notice is required, such delays shall not entitle the Contractor to additional compensation or to an increase in contract time.
- h. Fire, Police, Post Office, Transit, School Bus Notification. Contractor shall provide a minimum of 48 hours (*2 work days*) notice to police, fire department and post office prior to any work that will impact vehicular traffic, and ensure that alternate emergency access is available. Provide a minimum 1 week (*5 work days*) notice to any transit district or school district of any traffic impacts on streets which are on bus routes (*Contractor to verify routes*), and verify that arrangements are made for alternate routes.

- i. Garbage/Recycle Notification. Contractor shall provide a minimum 1 week advance notice for the garbage/recycle collector, and make arrangements for the garbage and/or recycle receptacles at all properties to be placed at a location where they can be collected on the appropriate day(s).

3.5 INTERRUPTION OF SEWER OR WATER SERVICE

- a. When work performed by Contractor will impact or interrupt water or sewer utility service to any public or private property, Contractor shall notify all the affected parties prior to the anticipated impact a minimum of 48 hours in advance.
- b. In addition, Contractor shall provide door hangers or equivalent a minimum of 24 hours (*and a maximum of 48 hours*) before such interruption of utility service to all residences, structures or businesses impacted by the work.
- c. Contractor is responsible to coordinate with the City staff a minimum of 1 week prior in order to verify area of impact or interruption.
- d. In addition to the written notice, a representative of the Contractor shall knock on the front door of all affected residences or businesses on the morning that the work will commence, and attempt to notify the residents or businesses regarding the start of the work.

3.6 TIMING & COORDINATION OF CONNECTIONS TO EXISTING, IN-SERVICE MAINS

- a. Timing of Connections. Unless otherwise approved in writing by the Owner and the jurisdiction with authority, connections to existing in-service water, sewer or storm drain mainlines (*or installation of fittings on or in such pipelines*) shall not occur on a weekend, or on a Friday or on any day that precedes a holiday.
- b. Coordination of Connections. The Contractor shall coordinate to ensure that the Owner's inspectors or operators are notified and have the opportunity to be present during the connection operations. After completing the connection work, the Contractor shall ensure that a work crew remains at the site and immediately available to the Owner's Representative until after all connections to in-service mainlines have been returned to service and verified to be fully operational by the agency with jurisdiction.

3.7 COORDINATION OF STARTUP AND TEST OPERATION OF COMPLETE SYSTEM

- a. The Contractor shall be responsible for the coordination with all trades, subcontractors and/or suppliers as necessary for the testing and test operation of all equipment, electrical and control systems to demonstrate that the total system operates as specified and shown on the drawings, and that all system components operate correctly and communicate with all other system components as necessary for a complete and operable system.
 - 1) The Contractor shall schedule a witness test by the Owner's representatives and staff, at a time acceptable to the Owner, with a minimum of 72 hours (*three business days minimum*) notice provided to allow all parties to be scheduled. Unless otherwise approved by the Owner's representative, this shall not occur on weekends, or on a Monday, Friday or the day before a holiday.

- 2) Such test operation shall be performed with the Owner's Representative and the Owner's operators present, and after the startup and testing and certification (*by each respective manufacturer's representative*) of all equipment, control systems, auxiliary power generator & ATS, telemetry and communications systems, and after all control system programming is completed and installed, whether such programming is by the Contractor or by the Owner.
- 3) The Contractor's personnel shall operate or arrange for the operation of all systems and equipment under normal and alarm conditions and simulate all operating modes of all of the equipment, including all alarm conditions, and verify proper alarm notification via autodialer or telemetry as applicable.
- 4) Any and all trips by the respective trades, subcontractors and/or suppliers as required to accomplish this shall be incidental work for which no additional payment will be made.

3.8 WARRANTY INSPECTIONS.

- a. In addition to the initial training specified for new equipment & systems, the Contractor shall provide one (1) field inspection (*and coordinate inspection by representatives of major equipment manufacturers*) near the end of the first year of service to inspect the equipment, make any necessary adjustments and coordinate for followup instruction of operating personnel to assure proper performance of the system.
- b. Where a 2 year warranty is provided, the Contractor shall provide another field inspection near the end of the second year of service to inspect the equipment, make or coordinate any necessary adjustments and instruct operating personnel to assure proper performance of the system.
- c. These services shall be scheduled with the Owner, and shall be furnished without cost to the Owner.

3.9 EXISTING SURVEY MONUMENTS DISTURBED DURING CONSTRUCTION

- a. The Contractor shall be responsible for locating and marking all existing survey monuments of record (including but not limited to property and street monuments) prior to construction.
- b. If any survey monuments are removed, disturbed or destroyed during construction of the project, the Contractor shall retain and pay for the services of a Registered Professional Surveyor licensed in the State of Oregon to reference and replace all such monuments in accordance with ORS 209.150.
- c. Each monument shall be replaced within a maximum of 90 days of its being removed, disturbed or destroyed. The surveyor shall notify the County Surveyor in writing of all such monuments replaced, and provide all documentation required by the County Surveyor. All monument replacement work shall be completed prior to final payment by the Owner.

3.10 FIELD RECORD DRAWINGS AND AS-BUILTS

- a. The Contractor shall maintain a neatly marked set of full size record drawings showing the locations and depths of all new and existing waterlines, storm and sanitary sewer laterals, buried conduits and other utilities encountered or installed during construction. Drawings shall be kept current with the work as it progresses and shall be subject to inspection by the Owner's Representative at any time. Failure to keep field record drawings current may result in the issuance of a stop work order or delay in the processing of pay requests until the record drawings are made current.
- b. Prior to final payment, the Contractor shall submit a clean set of full size record drawings to the Owner's Representative. All information shown on the Contractor's field record drawings shall be subject to verification by the Owner's Representative.
- c. The record drawings shall accurately show all as-built conditions, locations and alignments, and shall include all information required by individual sections herein, as well as the following. If significant errors or deviations are noted by the Owner's Representative, an as-built survey prepared and stamped by a registered professional Land Surveyor shall be completed at the Contractor's expense.
 - 1) Sanitary Sewer Mainline - Service tap stationing, manhole and cleanout stationing, and invert.
 - 2) Sanitary Sewer Services - Length from mainline and depth at property line with side ties to property pin.
 - 3) Water Mainline - Station and depth of all fittings, valves and service taps.
 - 4) Water Services - Length from mainline and side tie to property pin.
 - 5) Storm Sewer - Manhole and catch basin stationing and invert elevations.
 - 6) Existing Utilities - Station locations and depth at location where new utilities cross-existing utilities.
 - 7) Buildings & Mechanical/Piping Systems - As-built configuration, alignments and details, including any changes to the information shown on the drawings.
 - 8) Electrical & Controls – Complete as-built information showing actual conduit alignments (buried & above grade), the final locations of panels, field mounted instruments and panels, terminal boxes, junction boxes, receptacles, light switches and other materials shall be shown, as well as conduit routing between them to the extent it differs from the design drawings, as well as as-built electrical & control schematics, in addition to any other information required by Division 16.

3.11 CONFORMITY WITH DRAWINGS AND ALLOWABLE DEVIATIONS

- a. Finished surfaces in all cases shall conform to lines, grades, cross sections and dimensions shown on the approved drawings. Deviations from the approved drawings and working drawings will in all cases be determined by the Owner's Representative and authorized in writing.

3.12 CONTRACTOR RESPONSIBILITY TO OBTAIN ALL REQUIRED INSPECTIONS

- a. The Contractor shall be responsible to ensure that all inspections required by the drawings, contract documents or agencies having jurisdiction are completed by authorized inspectors prior to proceeding with subsequent work which covers or which is dependent on the work to be inspected.
- b. Work completed or covered without obtaining required inspections will be considered as unauthorized work as outlined below, and may be ordered removed at the Contractor's expense. Failure to obtain necessary inspection(s) and approval(s) shall result in the Contractor being fully responsible for all problems and/or corrective measures arising from uninspected work.

3.13 CONTRACTOR RESPONSIBLE TO PROVIDE ACCESS FOR INSPECTIONS

- a. Contractor shall be responsible to provide the Owner, Engineer and their subconsultants and representatives with safe and proper access to all portions of the work as necessary for inspection and/or testing purposes (*see also applicable General Condition provisions*).
- b. The Contractor shall be responsible for coordinating and scheduling to provide such inspection access at reasonable times, so as not to interfere with or delay the progress of the work by the Contractor or subcontractors.

3.14 COOPERATION OF CONTRACTOR

- a. The Contractor shall conduct his operations so as to interfere as little as possible with those of the Owner, other Contractors, utilities, or any public authority on or near the work. The Owner reserves the right to perform other work (by contract or otherwise) on or near the project during progress of the work. The Owner reserves the right to permit other public bodies, public utility companies and others to do work on or near the project during progress of the work. If a conflict arises, the Owner shall determine when and how the work shall proceed.
- b. Claims for delay or inconvenience due to operations by such other parties for work which is specified or referenced in the Contract Documents, or which is shown, noted or referenced on the drawings, will not be allowed.

3.15 ORAL AGREEMENTS

- a. No oral agreement or conversation with any officer, agent or employee of the Owner, either before or after execution of the Agreement, shall affect or modify any of the terms or obligations contained in any of the documents comprising the Agreement. Any such oral agreement or conversation shall be considered as unofficial information and in no way binding upon the Owner.

3.16 MANDATORY PROJECT SUPERINTENDENT

- a. Failure to provide or maintain a primary project superintendent as required by the provisions below and elsewhere in these contract documents shall be considered sufficient cause for termination of the Contract, or such other action the Owner's Representative may deem to be

appropriate (*including but not limited to issuance of a stop work order until the Contractor addresses the situation in a manner acceptable to the Owner's Representative, notification of bonding company, etc.*). A stop work order issued due to failure to provide and maintain an acceptable project superintendent shall not be grounds for a claim for additional contract time or additional contract price.

- b. The Contractor shall designate one person as primary project superintendent to oversee and coordinate construction. This project superintendent's work time shall be devoted exclusively to this project to ensure that work coordination, quality and time lines are met. If the Contractor is a joint venture, Contractor shall designate one person from the joint venture organization, with the required qualifications, to act as project superintendent.

The project superintendent shall be capable of reading and thoroughly understanding the plans and specifications, and shall be thoroughly experienced in the type of work being performed. The Owner's Representative may, at his/her sole discretion, request a summary of such prior experience be submitted prior to start of the work, or at any time during the project.

The project superintendent shall be acceptable to the Owner's Representative, including having a satisfactory record of experience and performance, and a satisfactory record of integrity.

- c. The Project Superintendent shall:

- 1) Be appointed in writing.
- 2) Keep one complete set of Contract Documents available on the project at all times at a location available for reference by personnel performing the work, and maintain complete copies of all change orders, submittals, project correspondence and other project information at an accessible location for reference by supervisory personnel directing or performing the work.
- 3) Ensure that the finished work complies completely and accurately with the Contract Documents.
- 4) Have full authority and responsibility to promptly supply the materials, equipment, tools, labor and incidentals required for the work.
- 5) Have full authority and responsibility to execute orders or directions of the Owner's Representative without delay.
- 6) Be available at all times to the Owner and Owner's Representative for contact by telephone or radio.
- 7) Carefully protect and preserve the Surveyor's and/or Engineer's marks and stakes.
- 8) Furnish the Owner's Representative every reasonable facility necessary for obtaining information regarding the nature, quantity and quality of any part of the work.
- 9) Allow the Owner's Representative reasonable access to the Contractor's books and

records at all times. The Owner's Representative will honor a request for confidentiality to protect trade secrets.

- 10) Ensure that all Contractor and subcontractor personnel understand and conform with the conduct requirements of the Contract Documents relating to interactions with private citizens and property owners or their representatives.
 - 11) Be on the project at all times work is underway, except as permitted.
- d. For short periods of time during the performance of minor or incidental portions of the work, the Contractor may designate another person to act for the superintendent on a temporary basis, subject to approval of the acting superintendent by the Owner's Representative.
- 1) This designation of acting superintendent must be in writing, and shall be arranged a minimum of one (1) week in advance with (and be approved by) the Owner, and shall state the person's name, position and scope of authority (*ie. it must state that the designated person is authorized as acting superintendent for the Contractor, with full authority to act in that capacity*).
 - 2) The specific duration of the appointment shall also be stated in writing (*ie. blanket designations of an acting superintendent is not acceptable, since each significant absence of the primary superintendent must be arranged with the Owner's Representative prior to such absence, except in cases of emergency*).
 - 3) The acting superintendent shall be available to the Owner's Representative at all times for contact by telephone or radio.

3.17 EMERGENCY MAINTENANCE PERSONNEL

- a. The Contractor shall submit to the Owner/Owner's Representative the names, addresses and telephone numbers of two employees responsible for performing emergency maintenance and repairs when the Contractor is not working. These employees shall be designated, in writing by the Contractor, to act as his representatives and shall have full authority to act on his behalf.
- b. At least one of the designated employees shall be available for a telephone call any time an emergency arises.

3.18 CONDUCT

- a. The Contractor and his personnel shall at all times be civil and courteous around private citizens and property owners, as well to the Owner's Representative or staff. If ever directed to leave private property by the property owner or his representative, the Contractor and his personnel shall do so immediately. If any property owner or his representative makes demands, the Contractor is to remain courteous and report the matter to the Owner's Representative. Foul or abusive language, obscene gestures, use of obscenities, or rudeness directed to private citizens (or to the Owner's Representative or staff) will not be tolerated.
- b. Use of radios and personal stereos with headphones (including walkmans, iPods, MP3 players, etc.) will not be permitted, unless headphones are OSHA approved and allow users to hear alarms, warnings, etc.

- c. If, in the Owner's Representative's opinion, the Contractor or any of his men fail to conduct themselves as stipulated above or follow the direction of the Owner's Representative, the Owner's Representative shall bar the offending individual from the project. His order shall be final.

3.19 DEFECTIVE OR DAMAGED EQUIPMENT OR MATERIALS

- a. All equipment and materials shall be carefully inspected by the Contractor upon arrival at the jobsite for defects or damage (including freight or shipment damage). Unless delivery of defective or damaged equipment or material is rejected by the Contractor and is not unloaded, the Contractor shall immediately notify the Owner's Representative about any damaged or defective material or equipment delivered to the jobsite.
- b. No material or equipment shall be installed which is known to be defective or damaged, without the prior written approval from the Owner's Representative. Any defective or damaged material or equipment discovered after installation shall be removed and replaced with new material or equipment at the Contractor's expense (in a manner satisfactory to the Owner's Representative), unless otherwise specifically approved in writing by the Owner's Representative. Such written approval (pre-installation or post-installation), if granted, shall be based on a written application from the Contractor, as well as documentation from the material/equipment manufacturer and the bonding company, as summarized below.
- c. The request for acceptance of any defective or damaged material or equipment shall be submitted in writing by the Contractor to the Owner's Representative. Such request shall include the following as a minimum (Contractor shall be responsible for obtaining these items prior to submitting the official request for the Owner's review). Additional requirements may be imposed by the Owner as applicable (at its sole discretion).
 - 1) Written certification from the material or equipment manufacturer that the damage can be repaired to restore the material or equipment to its full, original capacity and function, and that after such repair it will fully comply with all specification requirements and all manufacturer's recommendations, with no restriction or limitation on any required warranty. The manufacturer's certification shall include a detailed summary of all proposed repair procedures (as well as the qualifications or certifications required of the party who will complete the repair), as well as a summary of post-repair inspections and tests to be completed by the manufacturer's representative.
 - 2) Written consent from the Contractor's surety acknowledging that the surety concurs with the request, and that the provisions of all bonds will remain in full effect and force, without limitation or restriction.
- d. Notwithstanding the Owner's right (at its sole discretion) to accept defective or damaged equipment or materials (subject to completion of acceptable repairs/inspection/testing), this shall impose no obligation on the Owner to grant such acceptance.
- e. If the Owner or the Owner's Representative decide to reject any defective or damaged material or equipment (before or after submittal of a request by the Contractor), the Contractor shall be responsible to immediately and permanently mark or label the material or equipment as defective, and remove it from the job site within five (5) business days of

verbal or written notice by the Owner's Representative of such rejection.

3.20 REMOVAL OF DEFECTIVE OR UNAUTHORIZED WORK

- a. All work that does not conform to the requirements of these Contract Documents shall be considered as unacceptable.
- b. Contractor shall immediately remove unacceptable and defective work found to exist prior to acceptance of, or final payment for, the work. Replace with work and materials, which conform to the Contract Documents, or remedy otherwise in an approved manner. This provision shall have full effect regardless of the fact that the unacceptable work may have been done or the defective materials used with the full knowledge of the Inspector.
- c. Work done beyond the lines shown on the drawings or ordered, work done without required inspection, or any extra work done without authority will be considered as unauthorized and will not be paid for under the provisions of these Contract Documents. Work so done may be ordered removed at the Contractor's expense. Work done without lines and grades being given may also be considered as unauthorized and will be subject to rejection.

3.21 UTILITY CONFLICTS

- a. The Contractor shall not deviate from the design line and grade stated in these Contract Documents without the approval of the Owner's Representative.
- b. The Contractor shall be responsible for exposing potential utility conflicts far enough ahead of pipeline construction to make necessary adjustments in grade and alignment of the new work within the recommended limits of pipe and fitting deflection and/or the lines and grades stated in the Contract Documents. The Contractor shall field verify location and depth of all existing utilities where new facilities cross. All utility crossings marked or shown on the drawings shall be potholed as necessary prior to excavating or boring to allow the Contractor to prevent grade or alignment conflicts. Contractor shall employ hand tools or other non-invasive methods to determine the exact location and depth of the underground utilities at the designated locations, including both utilities marked in the field and those shown on the drawings.
- c. The Contractor shall be responsible for informing the Owner's Representative of the need for a grade and/or alignment adjustment. Contractor shall be responsible for exposing potential utility conflicts far enough ahead of construction to make necessary grade or alignment modifications without delaying the work. If grade or alignment modification is necessary, Contractor shall notify the Design Engineer, and the Design Engineer or the Owner's Representative shall obtain approval from the regulating authority prior to construction.
 - 1) Where failure to expose potential utility conflicts in advance results in the necessity of removing and/or relocating newly laid pipe, utilities or other infrastructure; this additional work shall be performed by the Contractor at no additional expense to the Owner.

3.22 PROTECTION OF EXISTING FACILITIES

- a. The Contractor shall protect from damage due to his operations, all existing facilities

including but not limited to survey monuments, fence lines, trees, underground utilities, drainage facilities, landscaping, roadway surfaces etc., which are not specifically designated for removal or alteration. The locations of these facilities as shown on the plans were derived from the best information available. However, the completeness and accuracy of these locations as shown is not guaranteed. It shall be the responsibility of the Contractor to verify the existence, size and locations of underground facilities in advance of construction. Any existing facilities not designated for removal or alteration, which are damaged by the Contractor's operations shall be restored or replaced to an "in kind" or better condition at the expense of the Contractor. The Contractor shall notify all public and private utility companies serving in the area in advance of construction, so underground utility locations can be confirmed and existing facilities relocated if necessary to facilitate construction. Contractor shall make excavations and borings ahead of work, as necessary, to determine the exact location, size and depth of existing underground utilities.

- b. At least a week in advance of beginning work, the Contractor shall notify the registered underground protection service, all public bodies and other owners of such facilities of the proposed location of his operations, advising them that their property may be affected and that such measures as they may deem necessary should be promptly taken to protect, adjust, remove and/or build them. Contractor shall comply with rules set forth in OAR 952-001-0010 through OAR 952-001-0090.
- c. Three conditions which may be encountered will be dealt with as follows:
 - 1) Structures, which are adjacent to but not included within the limits of an excavation required for performance of the work, shall be acceptably protected, supported and maintained in service by the Contractor at his expense.
 - 2) Structures within the limits of the work which can be satisfactorily supported and maintained in service and which do not require removal and rebuilding in the judgment of the Owner's Representative, shall be thus supported by the Contractor at his expense, including cost of repair of damage incidental to his operations.
 - a) Supports for water and gas mains, sewers, conduits and similar structures shall be constructed of timber or other acceptable materials, shall be supported on undisturbed foundations and shall be sufficiently substantial to ensure against settlement when pipe trenches or other excavations are backfilled. In all cases where permits or inspections fees are required by utilities in connection with changes to or temporary support of their conduits, the Contractor shall secure such permits and pay all inspection fees.
 - b) The Contractor shall assume full responsibility for maintaining all public utility structures in service and shall support and protect, or remove and rebuild them at his own expense. Such services shall not be interrupted without permission of the owner of the Public utility structure.
 - 3) In cases where the Contractor's failure to pothole and verify the location, depth and size of existing utilities in advance of the work results in direct interference with the installation of the work, the contractor shall either remove and/or relocate newly laid pipe as required to resolve the conflict, or relocate the existing pipeline or other utility structure at no additional cost to the Owner. Any such relocations shall be

approved by the Engineer and the regulating authority. The Contractor will not be paid for time lost or delay due to such direct interference. Where it is the policy of any utility owner to perform such work with his own forces, the Contractor shall cooperate to the fullest extent with such utility owners. All work shall be done in a manner to protect the public and the work.

3.23 TEMPORARY FENCING

- a. If existing fencing or other barriers are temporarily removed during construction for any reason, the Contractor shall coordinate in advance with the affected property owner or agency, and shall provide temporary fencing adequate to provide equivalent security as provided by the existing fencing or barriers which are removed (*including but not limited to containing or enclosing pets, livestock, children, etc.*).

3.24 PROTECTION OF PROPERTY

- a. Protect all public and private property, insofar as it may be endangered by operations and take every reasonable precaution to avoid damage to such property.
- b. Restore and bear the cost of any public or private improvement, facility, or structure within the right-of-way or easement which is damaged or injured directly or indirectly by or on account of any act, omission, or neglect in the execution of the work and which is not designated for removal but visibly evident or correctly shown on the plans. Restore to a condition substantially equivalent to that existing before such damage or injury occurred, by repairing, rebuilding, or otherwise affecting restoration thereof, or if this is not feasible, make a suitable settlement with the owner of the damaged property, all at no expense to the Owner.
- c. Give reasonable notice to owner's and occupants of buildings or property within or adjacent to the work to permit the occupants to remove vehicles, trailers, and other possessions as well as salvage or relocate plants, trees, fences, sprinkler systems, or other improvements in the right-of-way which are designated for removal or which might be destroyed or damaged by work operations.
- d. Protect all designated trees and planted areas within the right-of-way or easements. Exercise care and conduct operations so as to minimize damages to other planted areas.
- e. Review with Owner's Representative the location, limits and methods to be used prior to clearing work. Clearing and grubbing shall be performed in strict compliance with all local, State and Federal laws.
- f. The Contractor shall be responsible for the protection of public and private property adjacent to the work and shall exercise due caution to avoid damage to such property. Where such damage occurs, restore to a condition substantially equivalent to that existing before such damage or injury occurred, by repairing, rebuilding, or otherwise affecting restoration thereof, or if this is not feasible, make a suitable settlement with the owner of the damaged property, all at no expense to the Owner.
- g. The Contractor shall repair and replace all existing improvements within the right-of-way, easement, and permit of entry areas which are not designated for removal (examples are curbs, sidewalks, storm drains, water mains, sanitary sewers, driveways, fences, walls signs,

utility installations, pavements, structures, sprinkler lines) which are damaged or removed as a result of the contractor's operations. Repairs and replacements shall be equal to or better than existing improvements and shall match them in finish and dimension.

- h. Trees, lawns, and shrubbery that are not to be removed shall be protected from damage or injury. If damaged or removed because of the Contractor's operations, they shall be restored or replaced in, as nearly the original condition and location as is reasonably possible. Lawns shall be reseeded after replacement of topsoil and covered with suitable mulch except as noted otherwise.
- i. The costs to the Contractor for protecting, repairing, removing, replacing, or restoring existing improvements not required as a part of this work shall be incidental to other bid items.
- j. Until acceptance of the project, at all times protect from damage and preserve all materials, supplies, equipment of any description, and all work already performed, from the nature of the work, the action of the elements, and damage by any person or persons, or from any other cause whatsoever.

3.25 RESTORATION & REPAIR TIME FRAME

- a. Repair and restoration of any public or private improvement, facility, or structures as specified under the contract documents or by standards of jurisdictions with authority, shall be completed by the contractor in a timely manner, subject to any specific timeframes in the individual specification sections, drawings notes, general conditions or directives by jurisdictions with authority.
- b. Where damage caused by the contractor results in a danger to public health or safety of persons or the work or property at the site or adjacent thereto, the Contractor is obligated to act immediately to prevent threatened damage, injury, or loss, and complete any repairs as soon as possible, at no additional cost to the Owner.

3.26 RESTORATION AND CLEANUP

- a. Periodically, or as directed by the Owner's Representative, as the work progresses, and immediately after completion of the work, clean up and remove all refuse, debris, equipment, and unused materials of any kind resulting from the work. Upon failure to do so within 72 hours after directed, the work may be done by the Owner or third party and the cost thereof be deducted from any payment due the Contractor.
- b. As a condition precedent to final acceptance of the project, remove all equipment and temporary structures, and all rubbish, waste, lathe, flagging, etc., and generally clean up the right-of-way and premises to conform substantially to conditions as they existed before the commencement of work, as approved.
- c. All disturbed areas shall be graded to form a smooth, free draining surface. Contractor shall seed and mulch all exposed slopes not scheduled to be landscaped.

3.27 HOURS OF WORK

- a. Working hours for noise producing construction activities shall be from 7:00 a.m. and 6:00

p.m., Monday through Friday, excluding Federal, State and local holidays, unless longer hours are approved by the agency with jurisdiction, or unless shorter hours are dictated under any permit issued by the agency with jurisdiction.

3.28 DISPOSAL OF DEBRIS

- a. All debris resulting from construction operations, i.e., packaging, waste materials, damaged equipment, etc., shall be trucked from the site by the Contractor and disposed of at an approved off site location.
- b. The Contractor shall police the hauling of debris to ensure that all spillage from haul trucks is promptly and completely removed.
- c. All debris shall be disposed of in accordance with Federal, State and City rules and regulations.
- d. Excavated materials not suitable or not required for backfill or embankment shall be deposited on one or both of the following waste sites:
 - 1) Waste sites designated in the Contract Documents.
 - 2) Waste sites provided by the Contractor.
- e. All costs for disposing of this excess material shall be incidental to other items of work contained in the bid unless otherwise specified.
- f. All waste sites (whether on-site or offsite) shall be operated in such a manner as to meet all safety and health requirements of State and local agencies. Sites operations, or the result of such operations, which create a nuisance problem, or which result in damage to public or private properties will not be permitted.
- g. Permits for dumping on sites designated in the Contract Documents will be provided by the Owner. Contractor shall obtain permits for other sites at no expense to Owner. Furnish copies of issued permits to Owner's Representative prior to commencing filling operations.
- h. Do not deposit materials on any unimproved dedicated street right-of-way without written permission of the Owner's Representative and the agency with jurisdiction over the right-of-way.

3.29 TRESPASS

- a. The Contractor will be solely responsible for any trespass upon private property or injury thereto resulting from or in connection with his operations. He will be liable for any claims made because of his trespass or his deposit of debris of any kind on private property.

3.30 FINAL INSPECTION

- a. When all construction work on the project is complete and all extra work bills, forms and documents required under the Contract are submitted, notify the Owner's Representative in writing. Owner's Representative will make an inspection of the project and project records within 15 days of receiving said notice. If, at such inspection, all construction provided for

and ordered under the Contract is found completed and satisfactory and all certificates, bills, forms, and documents have been properly submitted such inspection shall constitute final inspection.

- b. If work is found unsatisfactory, or if all certificates, bills, forms and documents have not been properly submitted, the Owner's Representative will so notify the Contractor. After correction are made, or all certificates, bills, forms, or documents are properly submitted, notify the Owner's Representative in writing. Owner's Representative will make another inspection within five (5) days after such notice, and if all work is satisfactory, then this inspection shall constitute the final inspection.

3.31 USE OR POSSESSION PRIOR TO FINAL COMPLETION

- a. The Owner or his agents shall have the right to take possession of or use for his own benefit any completed or partially completed part of the work. Such possession or use shall not be deemed an acceptance of the occupied portion of the project. While the Owner is in such possession, the Contractor shall be relieved of the responsibility for injury or damage to the said completed portion of the work other than that resulting from the Contractor's fault or negligence. Continued operation or use of facilities being rehabilitated shall not be construed as use or possession prior to final completion.
- b. Prior to the Owner or his agents taking possession of or using any completed or partially completed part of the work, written notice shall be given by the Owner's Representative to the Contractor at least 24 hours in advance of the Owner actually assuming possession.

3.32 SUBSURFACE DATA

- a. All information obtained by Owner's Representative regarding subsurface conditions and groundwater elevations will be available for inspection at the office of the Owner's Representative upon request.
- b. Logs of test holes, test pits, soils reports, groundwater levels, and other supplementary subsurface information are offered as the best available information of underlying materials and conditions at the locations actually tested. The Owner will not be liable for any loss sustained by the Contractor as a result of any variance between conditions contained in or interpretations of test reports and the actual conditions encountered during progress of the work.
- c. Contractor shall examine the site and available records. The submission of a Bid shall be conclusive evidence that the Bidder has investigated and is satisfied as to the subsurface conditions to be encountered as to the character, quality, and quantities of work to be performed and materials to be furnished, and as to the requirements of the Contract Documents.

3.33 TEMPORARY WATER, HEATING, LIGHTING AND POWER

- a. The Contractor shall provide all water, heat, lighting and power required to construct and protect the work until the work is placed in service by the Owner for beneficial use of the Owner.
- b. The source for temporary power shall be from the electric utility or Owner approved

Contractor supplied auxiliary power units.

- c. The source for temporary water shall be from the City water utility or from Owner's distribution system, if the Owner's system is capable of supplying the temporary water.
- d. The Contractor shall pay the Owner for all-electric power and water utilized by the Contractor in the construction of the facility.
- e. The installation for electric power shall meet the requirements of local authorities and of OSHA.
- f. The Contractor shall obtain all permits and pay all costs for connecting temporary services at no expense to the Owner.

3.34 BARRICADES

- a. The Contractor must provide and maintain proper barricades, fences, signal lights, flares or watchmen to properly protect the work, equipment, persons, animals and property against injury.
- b. In areas of public travel and/or on all approaches leading to this work, all barricades and obstructions shall be illuminated at night. All lights for this purpose shall be kept burning from sunset to sunrise.
- c. Temporary traffic control devices and facilities shall be furnished, erected and maintained in accordance with all Local and State requirements.

3.35 MAINTAINING TRAFFIC & OWNER ACCESS

- a. Where Contract work is within streets or other public thoroughfares, the Contractor shall so plan and schedule his work as to cause as little interference with general public traffic. Street surfaces shall be maintained and kept clean where construction work under this Contract has been performed until inspection and acceptance of all such work.
- b. Access of fire, police and ambulance vehicles to property abutting and adjacent to such thoroughfares shall be maintained whether or not permission has been granted to restrict other traffic. The Contractor shall obtain all permits from Municipal, County, State or other authority having jurisdiction over traffic in thoroughfares, and shall comply with all regulations and directions of such authority concerning erecting barricades and detouring movement of traffic.
- c. The Contractor shall maintain the roads and all weather access-ways for operating personnel, deliveries of operating supplies, normal maintenance vehicles and other equipment incidental to the operation and maintenance of the Owner's facility.

3.36 SANITARY REGULATIONS

- a. Necessary housing accommodations shall be provided for the workers for changing clothes and for protection during inclement weather. Toilet accommodations shall also be maintained for the use of the employees on the work site. The accommodations shall be in approved locations, properly screened from public observance and shall be maintained in a

strictly sanitary manner. The Contractor shall obey and enforce all other sanitary regulations and orders and shall take precautions against infectious diseases. The Contractor shall maintain at all times, satisfactory sanitary conditions around all shanties, tool and supply houses and on all other parts of the work all in accordance with all Federal, State and Local ordinances, regulations and requirements.

3.37 DUST CONTROL

- a. The Contractor shall apply water or dust palliative, or both, for the alleviation or prevention of dust nuisance caused by his operations. Dust control operations shall be performed by the Contractor at the time(s) as required or as ordered by the Owner. Failure of the Owner to issue such order will not relieve the Contractor of this responsibility. Unless otherwise specified, no direct payment will be made for any such work performed or material used to control dust under these Contract Documents. The Contractor shall comply with all Federal, State and Local ordinances, regulations and requirements.

3.38 SMOKE PREVENTION

- a. Strict compliance with all ordinances regulating the production and emission of smoke will be required and the Contractor shall accept full responsibility for all damage that may occur to property as a result of negligence in providing required control. The Contractor shall comply with all Federal, State and local regulations.

3.39 CONTROL OF NOISE

- a. The Contractor shall eliminate noise to as great an extent as possible at all times. Air compressors shall be equipped with silencers and the exhaust of all gasoline motors and other power equipment shall be provided with mufflers. In the vicinity of hospitals, libraries and schools, precautions shall be taken to avoid noise and other nuisance. The Contractor shall require strict observances of all pertinent ordinances and regulations.

3.40 WEATHER CONDITIONS

- a. In case of temporary suspension of the work or during inclement weather, or whenever the Owner's Representative shall direct, the Contractor shall carefully protect (and cause his subcontractors to similarly protect) all work and materials against damage or injury from the weather. If, in the opinion of the Owner's Representative, any work or materials have been damaged by reason of failure on the part of the Contractor or any of his subcontractors to so protect his work, such materials shall be removed and replaced at the expense of the Contractor.

3.41 VERMIN CONTROL

- a. At the time of occupancy by Owner, any structure or structures entirely constructed under the Contract shall be free of rodents, insects, vermin or pests.

3.42 FAIR EMPLOYMENT PRACTICES ACT

- a. The Contractor agrees that neither he nor his subcontractors will discriminate against any employee or applicant for employment, to be employed in the performance of this Contract, with respect to his hire, tenure, terms, conditions or privileges of employment, or any matter

directly or indirectly related to employment, because of his race, age, color, sex, religion, national origin or ancestry or marital status. Breach of this covenant shall be regarded as a material breach of this Contract.

3.43 CONSTRUCTION ACCESS

- a. The Contractor shall be responsible for design, construction and maintenance of any and all structures required for access to the site for construction or delivery of materials, including but not limited to construction access roads and staging areas. The Owner's responsibility to provide access easements or right-of-ways to the construction site shall not be interpreted as relieving the Contractor of his responsibilities under this section.
- b. Unless otherwise shown or specified, the access road sections shown are based upon the anticipated loads following construction and not upon the loads during the construction period. Any increase in road size or depth required to accommodate the loads due to the Contractor's choice of construction methods or sequence of operations shall be the responsibility of the Contractor, and shall be supplied at no additional cost to the Owner.
- c. Any advice or recommendations solicited from or given by the Owner's Representative to the Contractor shall not relieve the Contractor of any of his responsibilities under this section.

3.44 USE OF EXPLOSIVES

- a. The use of explosives shall be prohibited.

3.45 MAINTAINING SEWER FLOWS (Sewage Hauling, Bypass Pumping or Sewage Bypass)

- a. All construction that requires interruption of sanitary sewage flow shall be executed during periods designated by the public agency with jurisdiction over the sewers (*interruption required for any reason due to work under this contract which may impact sewage flows, including during franchise utility company work associated with improvements under this contract*). Bypassing of untreated or partially treated wastewater to storm drains, ditches or surface waters is prohibited. Surcharging of upstream sewers is prohibited unless specifically approved in writing by the public agency with jurisdiction over the sewers.
- b. The methods used to haul, maintain, bypass or divert flow shall be the Contractor's design (subject to approval by the public agency with jurisdiction over the sewers). These methods may include sewage hauling, bypass plugs, bypass pumping, sewage hauling, use of mainline plugs with periodic release of sewage flow, or other methods proposed by the Contractor and approved by the Owner's Representative.
 - 1) If mainline plug and storage methods are proposed for use by the Contractor and approved by Public Works, a test shall be performed within 48 hours prior to commencement of the pipe bursting operations.
 - a) The Contractor shall provide the Owner's Representative a written estimate of the maximum amount of time anticipated for the mainline to be out of service. The duration of the test shall be for a minimum of 25% longer than the Contractor anticipates having the mainline out of service.
 - b) The test shall demonstrate to the satisfaction of the Owner's

Representative and Public Works that surcharging will remain a minimum of 4 feet vertically below the lowest finished floor of any structure served by the upstream system, or a minimum of 4 feet vertically below the lowest manhole rim in the upstream system, whichever is lowest, during the entire period of the test.

- c) If plug and storage methods are approved by the Owner's Representative, the Contractor shall have bypass pumping equipment and adequate hoses to provide bypass pumping available on site (in the event that the service interruption is longer than estimated by the Contractor). The Contractor shall demonstrate operation of the standby bypass pump to the satisfaction of the Owner's Representative within 24 hours prior to installation of the plugs.
 - d) If the mainline remains out of service longer than the time estimate provided by the Contractor, the bypass pump system shall be activated and placed in operation immediately, at no additional cost to the Owner.
 - e) All plugs shall be removed prior to the end of each workday, and full sewage flows restored.
- c. A bypass system shall not be left in place or operated outside of normal working hours without specific prior written approval from the Owner's Representative and Public Works.
- d. If a bypass pump system is left in place or operated outside of normal working hours (with approval from the City), it shall be monitored continuously by the Contractor personnel unless alternate arrangements are proposed by the Contractor and acceptable to the public agency with jurisdiction over the sewers (ie. high level alarm and pump fail alarm autodialer callout capabilities, etc.). Where such operation is proposed, the Contractor shall provide all submittal information required to demonstrate compliance with the requirements of the public agency with jurisdiction over the sewers.
- e. If sewage backup occurs and enters buildings or otherwise overflows (onto private property, streets, sidewalks, storm drains or any location other than an approved sanitary sewer), the Contractor shall be fully responsible and liable for all costs associated with any cleanup, repair, property damage, claims, regulatory fines, etc.
- f. Any bypass pumped sewage shall be in an enclosed hose or pipe that is adequately protected from traffic. Where bypass hoses cross traffic areas (street travel lanes or driveways), Contractor shall provide prefabricated road crossings (Road Crossings by RainForRent or approved equal) designed with sloped entrance & exit ramps and a 20,000 lb single axle load limit, unless a comparable site built ramp (acceptable to the Owner's Representative) is provided by the Contractor.
- g. Impacts Due to Surcharge Conditions, Documentation & Contract Time.
- 1) Working days will be counted against the contract time for any calendar day when flows are at or below capacity of the existing clean pipe (gravity flow without surcharging, after cleaning & any point repairs to remove obstructions are completed), regardless of whether or not the Contractor elects to work on that day.
 - 2) If all pipes within a schedule area are surcharged (ie. all pipes remaining to be rehabilitated or replaced), that calendar day will not be counted against the contract time, regardless of whether or not the Contractor elects to work on that

- day (subject to submittal of documentation demonstrating this as noted below).
- 3) The Contractor shall provide documentation to the Owner's Representative and Public Works demonstrating such surcharge conditions prior to noon on the day the surcharge is noted. If the Contractor fails to provide such documentation within this timeframe, the day will not be counted as a surcharge day.
 - 4) Any delays due to surcharged conditions will not entitle the Contractor to any increase in the contract price.

3.46 MAINTENANCE OF TREATMENT PLANT DURING CONSTRUCTION

- a. All construction, which requires interruption of treatment plant flow, shall be executed during periods designated by the Plant Superintendent. Bypassing of untreated or partially treated wastewater to the receiving stream will be prohibited.

3.47 TECHNICAL SPECIFICATIONS, CONFLICTS BETWEEN DRAWINGS & SPECIFICATIONS

- a. All materials and workmanship for public or private utilities, facilities or infrastructure shall conform to all Federal, State and Local codes & standards, and with the technical specifications contained herein.
- b. Materials and workmanship incorporated into the project must be acceptable to the Owner, Owner's Representative and approving agencies.
- c. Where a conflict occurs between or within the specifications and drawings, the more stringent or higher quality requirements shall apply (*engineer-of-record and agency with jurisdiction shall decide which stipulation will provide the best installation*).

PART 4: SPECIAL PROVISIONS

None.

SECTION 01090
REFERENCE STANDARDS

PART 1: GENERAL

1.1 SCOPE

- a. This Section includes reference standards.

1.2 DESIGNATION OF ASSOCIATIONS, INSTITUTIONS, SOCIETIES AND STANDARDS

- a. Whenever in these Specifications reference is made to Associations, Institutions, Societies or Standards, they will be designated as follows:

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturers Association
AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADA	American Disability Act
AFBMA	Anti-Friction Bearing Manufacturers Association
AFI	Air Filter Institute
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AIA	American Institute of Architects
AIHA	American Industrial Hygiene Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
API	American Petroleum Institute
APWA	American Public Works Association Standard Specifications, OSSC (ODOT/APWA)
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
BLIS	Bureau of Labor and Industries Standards
BLM	Bureau of Land Management
CDBG	Community Development Block Grant
CEMA	Conveyor Equipment Manufacturer's Association
CISPI	Cast Iron Soil Pipe Institute
COE	Corps of Engineers

CRSI	Concrete Reinforcing Steel Institute
DEQ	Department of Environmental Quality
DFPA	Division for Product Approval of American Plywood Association
DSL	Division of State Lands
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
FM	Factory Mutual
FmHA	Farmer's Home Administration (Rural Development)
FS	Federal Standards
IBC	International Building Code
IBR	Institute of Boiler and Radiator Manufacturers
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronic Engineers
IFC	International Fire Code
IRI	Industrial Risk Insurance
ISA	Instrument Society of America
ISO	Insurance Service Office
ITE	Institute of Traffic Engineers
JIC	Joint Industry Conferences of Hydraulic Manufacturers
MUTCD	Manual of Uniform Traffic Control Devices
NBS	National Bureau of Standards
NEC	National Electrical Code
NESC	National Electric Safety Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NLMA	National Lumber Manufacturer's Association
OAR	Oregon Administrative Rules
NSF	National Sanitation Foundation
OECD	Oregon Economic & Community Development (Business Oregon)
ODOT	Oregon Department of Transportation
OFC	Oregon Fire Code
OHA-DWS	Oregon Health Authority – Drinking Water Services
OPSC	Oregon Plumbing Specialty Code
ORS	Oregon Revised Statutes
OSHA	Occupational Safety and Health Administration
OSHD	ODOT, Oregon State Highway Division
OSSC/ODOT	Oregon Standard Specifications for Construction - OSSC (ODOT/APWA)
OSSC	Oregon Structural Specialty Code
PCA	Portland Cement Association
RD	Rural Development (USDA)
RUS	Rural Utilities Service (USDA)
SHPO	State Historic Preservation Office
SMACA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
SSPC	Steel Structures Painting Council
UBC	Uniform Building Code (see state structural code)
UFC	Uniform Fire Code (see state fire code)
UL	Underwriter's Laboratories, Inc.
UPC	Uniform Plumbing Code (see state plumbing code)
USBM	United States Bureau of Mines

WDOT..... Washington Department of Transportation
WWPA..... Western Wood Products Association

- b. Wherever specific standard numbers are indicated, i.e., ASTM C-150, it shall be understood to mean the latest revision thereof.
- c. Specification Language. Portions of the Specifications may be written in imperative and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” or “shall conform with” shall be included by inference where a colon (:) is used within sentences or phrases. Example – Aggregate: ASTM C33.

PART 2: PRODUCTS

None

PART 3: EXECUTION

None

PART 4: SPECIAL PROVISIONS

None.

SECTION 01200
PROJECT MEETINGS

PART 1: GENERAL

1.1 SCOPE

- a. These sections include all scheduling and administering of preconstruction and progress meetings as herein specified and necessary for the proper and complete performance of this work.

1.2 PRECONSTRUCTION MEETING

- a. Schedule: Owner's Representative to schedule the preconstruction meeting within 20 days of signature of the Contract by the Owner.
- b. Attendance:
 - 1) Unless otherwise directed by the Owner's Representative, representatives of the following parties are to be in attendance at the meeting:
 - a) Engineer
 - b) Major Contractor(s)
 - c) Representatives of governmental or regulatory agencies, when appropriate.
 - d) Utility companies
 - 2) Minimum Agenda: The agenda for the preconstruction meeting will typically consist of the following:
 - a) Verify distribution of construction drawings & Contract Documents.
 - b) Distribute and discuss a list of major subcontractors and a tentative construction schedule.
 - c) Chain of Command.
 - d) Designation of responsible personnel.
 - e) Critical work sequencing.
 - f) Processing of field decisions and change orders.
 - g) Submittal of shop drawings, project data and samples.
 - h) Procedures for maintaining record documents.
 - i) Use of premises, including office and storage areas and Owner's requirements.
 - j) Major equipment deliveries and priorities.
 - k) Security procedures.
 - l) Housekeeping procedures.
 - m) Processing procedures and schedule for progress payments.

1.3 PROGRESS MEETINGS

- a. Schedule: At the preconstruction meeting the location, date and time of periodic (weekly or every other week) progress meetings will be established.
- b. Attendance:
 - 1) Unless otherwise directed by the Owner's Representative, representatives of the following parties are to be in attendance at the meeting.
 - a) Engineer (as requested by the Owner)
 - b) Owner's Field Representative
 - c) Major Contractor(s)
 - d) Representatives of Governmental or Other Regulatory Agencies, as appropriate.
 - e) Utility companies, when appropriate.
- c. Agenda:
 - 1) The minimum agenda for progress meetings shall consist of the following (agenda for each meeting to be prepared by the Contractor):
 - a) Review and approve minutes of previous meetings.
 - b) Review work progress since last meeting.
 - c) Note field observations, problems and decisions.
 - d) Identify problems that impede planned progress.
 - e) Review off site fabrication problems.
 - f) Develop corrective measures and procedures to regain plan schedule.
 - g) Revise construction schedule as indicated.
 - h) Review submittal schedules; expedite as required to maintain schedule.
 - i) Maintenance of quality and work standards.
 - j) Review changes proposed by the Owner for their effect on the construction schedule and completion date.
 - k) Complete other current business.
- d. Minutes:
 - 1) The Contractor shall be responsible for preparing minutes of each progress meeting. Minutes to be distributed to attendees within five (5) calendar days of each meeting.

PART 2: PRODUCTS

None

PART 3: EXECUTION

None

PART 4: SPECIAL PROVISIONS

None.

SECTION 01300
CONTRACTOR CONSTRUCTION SUBMITTALS

PART 1: GENERAL

1.1 SCOPE

- a. Wherever submittals are required in the Contract Documents, the Contractor shall submit them to the Owner's Representative.
- b. Delivery prior to approval of any material or equipment for which submittals are required will be at the Contractor's risk. Material or equipment for which submittals are required shall not be incorporated into the work until after the submittals have been reviewed and approved.
- c. Construction Submittal Format & Number of Copies.
 - 1) Contractor will be allowed to provide electronic/pdf copies of highlighted/marked-up submittals and associated submittal cover sheet, conditional upon submittals being complete and configured in accordance with the requirements of this section.
 - 2) If the Contractor fails to provide submittals in full conformance with this section, the Owner's Representative may require all subsequent submittals to be submitted in hard copy format (three copies minimum).

1.2 PRECONSTRUCTION CONFERENCE SUBMITTALS

- a. Within 14 Days after the date of commencement as stated in the Notice to Proceed or at the preconstruction conference, whichever comes first, the Contractor shall submit the following items to the Owner's Representative for review:
 - 1) A preliminary list of Shop Drawings, Samples and proposed Substitutes.
 - 2) A preliminary schedule for submission of priority and major Shop Drawings (particularly long-lead time equipment) and Samples.
 - 3) A list of permits and licenses the Contractor shall obtain, indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
 - 4) A project schedule in accordance with Section 01305 - Construction Schedules.
 - 5) List of all subcontractors, including class of work, contact person & phone numbers.
 - 6) An Erosion Control Plan and schedule in accordance with Section 01568 - Erosion and Pollution Control.

1.3 GENERAL SUBMITTAL REQUIREMENTS

- a. Prior to Submitting Information to the Owner's Representative:
 - 1) The Contractor shall carefully review the correctness and thoroughness of the material, verify all field measurements, and coordinate all aspects of each item being submitted.
 - 2) The Contractor shall carefully review and ensure that all submittals are tailored to the project by highlighting appropriate information and/or deleting or crossing out non-applicable information, and that all options and equipment furnished are indicated, and ensure that the submittal is otherwise organized and marked as required herein or in the individual specification sections as applicable.
 - 3) **The Contractor shall verify his review by affixing his stamp of approval and signature to the front page of each copy of the submittal.**
- b. Direct Supplier/Subcontractor Submittals Not Accepted. All submittals to the Owner's Representative, with the exception of the laboratory test certificates or test results, shall be made only by the Contractor. Submittals from subcontractor or suppliers will not be accepted.
- c. Sequential Numbering. All submittals shall be numbered sequentially. Resubmittals shall be designated with the same number as the original submittal followed by a designation letter (ie. Submittal "5A" for the first resubmittal of submittal 5, Submittal "5B" for second, etc.).
- d. Specified Cover Sheet. All submittals shall be accompanied by a completed copy of the submittal report cover sheet included under Part 4 of this section.
 - 1) A separate submittal report cover sheet shall be prepared for each submittal. Generally, items under a single specification section can be included on the same submittal report. Each submittal report shall clearly designate the specification section(s) that apply to the material or equipment being submitted on.
 - 2) Except in the case of operations and maintenance manuals or as otherwise approved by the Owner's Representative, a single submittal report shall not be used for items under different specification sections.
 - 3) All submittal report cover sheets shall reference the item that it covers, the applicable specification section(s), the Contractor's name, the Contract title and location, and the date of submission. Submittal shall also indicate whether the information is for review and approval by the Owner's Representative, for record purposes or for the fulfillment of the operation and maintenance requirements.
- e. The Contractor shall provide copies of each submittal as follows unless otherwise directed in the individual Sections (*except where electronic/pdf copies of submittals are allowed as noted above*):
 - 1) Preconstruction Conference Submittals – Three (3) copies provided to Owner's Representative.
 - 2) Material and Equipment Construction Submittals – Three (3) copies provided to Owner's Representative if pdf submittal is dis-allowed as noted above.

- 3) Quality Control Submittals – The Contractor or the laboratory shall submit one copy of all test certificates, and calibration certificates directly to the following; Owner, the Owner’s Representative and Owner’s Field Representative.
- 4) Informational Submittals – The Contractor shall submit one copy of all licenses and permits directly to the following; Owner, Owner’s Representative and Owner’s Field Representative.
- f. Substitutions Shall be Noted. Manufacturers submitting proposals for material or equipment which will require changes to the design shown on the Drawings or specified herein (*or which are not fully & completely interchangeable with the specified material or equipment*) shall also include detailed information on structural, electrical, mechanical and other miscellaneous changes or modifications required to adapt their equipment to the design shown, as specified below and in the General Conditions. Provision of such information or acceptance for review shall not be construed as approval of such substitute.
- g. Highlighting and/or Marking. All submittals shall be tailored to the project by highlighting appropriate information and/or deleting or crossing out non-applicable information (*as well as being marked, labeled or identified as required in the individual specification sections, as applicable*). All options and equipment furnished shall be so indicated.
- h. Complete Submittals Required. Failure to provide complete submittals, or failure to follow the instructions outlined in this section (*including but not limited to highlighting applicable information and/or crossing out non-applicable information*), will result in the incomplete submittal being returned to the Contractor without review, at the discretion of the Owner’s Representative.
- i. Electrical / Control / Telemetry / SCADA Submittals. Contractor shall provide all of the electrical / control / telemetry / SCADA product data in Division 13 & Division 16 (as well as electrical items shown on the drawings by not included in the specifications) at the same time, unless specifically allowed otherwise in writing by the Owner’s project electrical engineer. Piecemeal submittals will be returned as incomplete.
- j. Re-Submittals to Address all Review Comments. The Owner’s Representative reserves the right to return, without review, any re-submittals which have not been modified to fully address all previous review comments.

1.4 SUBSTITUTIONS

- a. Substitute items of material or equipment are those items which are determined by the Owner’s Representative NOT to qualify as an “or equal”, or which require any level of redesign work on the part of the Engineer to incorporate into the project, or which are not fully interchangeable with the specified items or the Owner’s standard material & equipment (*see requirements under General Conditions*).
- b. Submittals for substitute materials or equipment shall include but not be limited to manufacturer’s literature, design criteria, dimensions and installation instruction.
- c. The submittal shall include any certifications or test results required to demonstrate that the proposed materials or equipment meets the requirements of the specifications and is equivalent or better than the specified materials or equipment.

- d. If the substitution requires a change in the design (*including dimensional changes to any structure or other component*), or which are not fully and completely interchangeable with the specified item(s), the submittal shall include all pertinent design information and details for the required design change, with supporting documentation.
- e. Reimbursement by Contractor for evaluation or redesign costs due to such substitution shall be dealt with as outlined under General Conditions 6.05.E as applicable.

1.5 MATERIAL AND EQUIPMENT SUBMITTALS:

- a. All Variances, Exceptions and/or Substitutions Shall be Noted.
 - 1) If the proposed equipment includes modifications from standard features or options typically provided by the manufacturer for similar applications, these shall be clearly noted on the submittal.
 - a) Failure to note variances from the specification requirements may result in the submittal being returned to the Contractor without review, if the discrepancy is discovered by the Owner's Representative.
 - 2) Required Summary. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
 - a) Contractor Responsibility. If the Contractor fails to clearly indicate all exceptions or variances from the requirements in the specifications or on the Drawings as noted above, and these differences, exceptions or variances are not discovered by the Owner's Representative during submittal review, the Contractor shall remain fully and completely responsible for correcting such discrepancies, regardless of when they are ultimately discovered, at no additional cost to the Owner and with no adjustment to the contract time.
- b. Project Sign Submittals. Submittals shall include shop drawings for notice or informational signs required by agencies with an interest in the project, including submittal information on posts, plywood backing and sign painting and/or placards.
- c. Material & Equipment Submittals. Submittals for all materials and equipment used by the Contractor in the performance of the work shall include the following as applicable.
 - 1) Manufacturers' Literature: Literature indicating the compliance of the product with the Specifications shall be included with all submittals. This shall include catalog sheets and other descriptive bulletins. Manufacturer's literature shall also include, but not be limited to the following:
 - a) Manufacturer's catalog data
 - b) Materials of construction
 - c) Manufacturer's name and model number
 - d) Installation instructions and drawings
 - 2) Manufacturers' or Suppliers' Certificates: Certificates shall state that the products have been sampled and tested in accordance with the proper industrial and governmental

standards and meet the requirements of the Contract Documents. An authorized agent of the manufacturer shall sign certificates.

- 3) Design Data: Design data shall include the calculations, supporting theories, safety factors and assumptions used in designing the product.
- 4) Samples: Samples shall be provided as required in the individual sections. Samples shall be of the precise material proposed to be furnished. The number of samples and sample size shall be of the industry standard unless otherwise stated in the individual sections.
- 5) Shop Drawings: Shop drawings shall include the following as applicable to the equipment or system along with any special requirements listed in the individual Specification Sections:
 - a) Scaled details
 - b) Scaled dimensional drawings
 - c) Sectional assembly drawings
 - d) Fabrication information
 - e) Wiring schematics with termination point identification
 - f) Motor information
 - g) Piping schematics

d. Structural/Seismic Calculations for Equipment or Materials:

- 1) When specified herein, noted on the drawings, or when required to conform with the provisions of the Oregon Structural Specialty Code (OSSC) or other referenced standards, structural/seismic calculations stamped by a professional engineer licensed in the State of Oregon shall be submitted for materials or equipment specified and/or proposed for use by the Contractor.
- 2) Where required or requested by any building official, the Contractor shall be responsible to provide any and all calculations and/or certifications required, at no additional cost to the Owner.

1.6 QUALITY CONTROL SUBMITTALS

- a. Quality Control submittals are defined as those required by the Specifications to present documentary evidence to the Owner's Representative that the Contractor has satisfied certain requirements of the Contract Documents. Such submittals may include but are not limited to:
 - 1) Laboratory Certificates: Certificates shall include the results of tests by an independent laboratory for comparison to Specification requirements, mix design data and approval, plan inspection reports and certification, and other required information from the laboratory. All information submitted shall be signed by an authorized agent of the laboratory.
 - 2) Installation and Calibration Certificates: Certificates shall be submitted for equipment as indicated in the individual sections. These certificates shall indicate manufacturer's satisfaction with the installation, the accuracy of calibration and alignment, and the operation of the equipment. An authorized agent of the manufacturer must sign such certificates.

1.7 INFORMATIONAL SUBMITTALS & SUBMITTALS FOR RECORD

- a. Informational submittals formalize the flow of information between the Contractor and the Owner's Representative. Such submittals may include but are not limited to:
 - 1) Construction Schedules: Unless otherwise specified, the Contractor shall submit construction schedules as outlined under Section 01305, Construction Schedules contained herein.
 - 2) Licenses and Permits: The Contractor shall obtain all licenses and permits required by Local, State and Federal laws and submit copies of them to the Owner's Representative, including but not limited to the following.
 - a) Copies of all construction permits and licenses required by all approving agencies, including as applicable cities, counties, state agencies, utility service districts, etc.
 - b) Copies of all building, structural, electrical, mechanical, and plumbing permits (as appropriate) required by all approving agencies.
 - c) Copies of County, ODOT and/or railroad right of entry permits (as applicable), including copies of permit conditions.

1.8 OPERATION AND MAINTENANCE INFORMATION

- a. The Contractor shall furnish copies of O&M manuals in accordance with specification section 01705.

1.9 OWNER'S REPRESENTATIVE'S REVIEW OF SUBMITTALS

- a. Except as may otherwise be indicated, the Owner's Representative will review the submittals with reasonable promptness for their compliance with the design concept and the Contract Documents and return a copy of each submittal to the Contractor with comments noted thereon or noted in a cover letter/memo.
 - 1) For projects where a pdf copy of the submittal is returned to the Contractor via email, the Contractor may request that a hard copy of any particular submittal also be provided to them.
 - 2) The Owner's Representative's maximum review period for each submittal or resubmittal will be 21 days.
- b. If the review indicates that the material or equipment is in general conformance with the design concept and complies with the Drawings and Specifications, submittal copies will be marked "REVIEWED". In this event the Contractor may begin to incorporate the material or equipment covered by the submittal.
- c. If the review indicates that limited corrections are required, the submittal will be marked "FURNISH AS CORRECTED". The Contractor may begin incorporating the material and equipment covered by the submittal in accordance with the noted corrections.
 - 1) Unless otherwise approved in writing by the Owner's Representative, the Contractor shall provide a written summary (*letter, memo or email*) confirming how each such

- “FURNISH AS CORRECTED” review comments will be addressed. A separate letter/memo/email shall be provided for each submittal (*subject line referencing the submittal number and title*), with confirmation of each applicable submittal review comment from the submittal review by the Owner’s Representative, with numbering to match the applicable submittal review comment.
- 2) If the requirement for written confirmation of “FURNISH AS CORRECTED” review comments is waived in writing by the Owner’s Representative, no further action is required by the Contractor.
 - 3) Where submittal information is to be incorporated into an O&M Manual, a corrected copy of all applicable submittals shall be prepared for inclusion in the O&M Manual.
- d. If a submittal is returned marked “REVISE AND RESUBMIT”, the Contractor shall revise it and shall resubmit the required number of copies to the Owner’s Representative for review.
- 1) Resubmittal of only portions of multi-page or multi-drawing submittals will not be allowed unless specifically requested or allowed by the Owner’s Representative (in the submittal review). For example, if a Shop Drawing submittal consisting of 10 drawings contains one drawing noted as “REVISE AND RESUBMIT”, the submittal as a whole is deemed “REVISE AND RESUBMIT”, and 10 drawings are required to be resubmitted.
 - 2) However, if a submittal includes numerous different items, each of which was reviewed and commented on separately, only those noted as “REVISE AND RESUBMIT” need to be resubmitted.
- e. If a submittal is returned marked “REJECTED”, it shall mean either that the proposed material or product does not satisfy the specification or the submittal is so incomplete that it cannot be reviewed. In such cases, copies will be returned to the Contractor for correction. The Contractor shall then resubmit the required number of copies of the corrected submittal.
- 1) Any material or equipment on-site which is rejected by the Owner’s Representative shall be removed from the job site by the Contractor within two (2) working days of notification of rejection of the submittal.
- f. Except at its own risk, the Contractor shall not undertake work covered by submittals marked as “REVISE AND RESUBMIT” or “REJECTED” until a new submittal is made and returned without exceptions.
- g. The Owner’s Representative’s review of submittals is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the submittals or shop drawings during this review (or absence of such corrections or comments) do not relieve the Contractor from compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the job site; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of his or her work with that of all other trades; and for performing all work in a safe and satisfactory manner.
- h. Upon acceptance, the Owner’s Representative will return a copy of the review submittal to the Contractor and the Owner.
- i. In the event that multiple reviews are performed on the same submittal (*or portions of the same submittal*) due to revisions, clarifications, duplicate submittals or other reasons, all submittal review comments are complementary and what is noted by any submittal review

iteration shall be as binding as if noted on all.

1.10 **RE-SUBMITTALS MUST ADDRESS ALL PREVIOUS REVIEW COMMENTS**

- a. The Owner's Representative reserves the right to return, without review, any re-submittals which have not been modified to fully addressed all previous submittal review comments.
- b. When a previous submittal review specifically directs the Contractor/supplier team **NOT** to resubmit the portions of the previous submittal which were approved, resubmittals including the same documentation (*for already approved items*) will be returned without review, unless otherwise determined by the Owner's Representative on a case-by-case basis (*in other words, the supplier is required to do the work required to provide a tailored resubmittal including only the material still needing to be reviewed and approved*).

PART 2: PRODUCTS

None.

PART 3: EXECUTION

None.

PART 4: SPECIAL PROVISIONS

4.1 **SUBMITTAL REPORT FORM**

- a. See following pages:

WESTECH ENGINEERING INC. SUBMITTAL REPORT

PROJECT: Aumsville Wastewater Treatment Plant Improvements

FROM: _____

TO: Westech Engineering

COPIES: 1 for pdf submittals, or three (3) if hard copies are required by Owner's Representative

SUBMITTAL NUMBER _____

Category of Information being Submitted:

- ☐ EQUIPMENT/MATERIAL SUBMITTALS/SHOP DWGS ☐ MANUFACTURER'S DATA
☐ REPORTS ☐ METHOD STATEMENT ☐ INFORMATION FOR RECORD
☐ SAMPLES ☐ OTHER ☐ OPERATIONS&MAINTENANCE MANUALS

DESCRIPTION: _____

SPECIFICATION SECTION & TITLE: _____

I hereby certify that the material submitted has been checked for compliance with the specification **and any variances, exceptions or substitutions have been clearly noted, and a list provided at the front of the submittal.**

Signed (*Contractor's authorized representative*)

Date

Printed Name

Title

RESPONSE TO SUBMITTAL (by Owner's Representative):

- ☐ REVIEWED ☐ FURNISH AS CORRECTED ☐ REJECTED
☐ REVISE AND RESUBMIT ☐ SUBMIT SPECIFIC ITEM ☐ SEE ATTACHED LETTER _____

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the submittals or shop drawings during this review (or absence of such corrections or comments) do not relieve the contractor from compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. Contractor is responsible for dimensions to be confirmed and correlated at the job site; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of his or her work with that of all other trades; and for performing all work in a safe and satisfactory manner.

Signed

Date

Printed Name

Title

SECTION 01305
CONSTRUCTION SCHEDULES

PART 1: GENERAL

1.1 SCOPE

- a. This Section includes, but is not necessarily limited to, the preparation, furnishing, distribution, and periodic revision of construction schedules as herein specified and as necessary for the proper and complete performance of this Work.

1.2 RELATED SECTIONS

- a. 01300 - Construction Submittals

1.3 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the following as a minimum:

- b. Overall Project Schedule

- 1) Initial Project Schedule

- a) The initial project schedule shall be submitted a minimum of 1 day prior to the preconstruction conference, or within 5 days after the effective date of the Notice to Proceed, whichever is sooner.
 - b) Regardless of review or comments regarding the schedule by the Owner's Representative, the Contractor remains responsible for ensuring that all work is sequenced and coordinated to complete the work within the specified contract time and contract milestones, including providing adequate time for inspections, testing and/or startup.
 - c) If required, resubmit revised project schedule within 7 days after receipt of review comments, if any.
 - d) No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

- 2) Periodic Updating: Updated project schedules shall be submitted with all pay requests, accurately depicting progress to the time of the pay request submission and showing the anticipated project schedule from that time forward.

- 3) Number of Copies: Submit three (3) copies to be retained by the Owner's Representative, plus the number of copies required by the Contractor for distribution to subcontractors and/or suppliers.

c. Two-Week Work Schedules:

- 1) Two-Week schedules shall be prepared starting from the notice to proceed date until the date of substantial completion.
- 2) The deadline for submittal (by email, fax or delivery) of the two-week work schedules shall be as follows, with copies to the Owner and the Owner's Representative:
 - a) Projects with weekly progress meetings: By the end of business on the business day before the meeting, to allow time for the Owner and Owner's Representative to review.
 - b) Projects without weekly progress meetings: By no later than 4:00 p.m. of the last regular workday of each week.

PART 2: PRODUCTS

2.1 OVERALL PROJECT SCHEDULE

a. Form of Overall Project Schedule: The overall project schedule shall:

- 1) Be in the form of a bar chart showing the proposed operations. The schedule shall be complete and show in detail the manner in which the contractor proposes to complete the work within the specified time.
- 2) Be prepared in the chronological order showing the beginning and end of each item of work.
- 3) Include the date that the schedule was prepared and/or last modified.
- 4) Identify each path by:
 - a) Major specification section number or title.
 - b) Distinct graphic delineation.
- 5) Use a horizontal time scale and identify the first work day of each week.
- 6) Allow space for updating.
- 7) Not be larger than 24" x 36" unless approved by the Owner's Representative.

b. Content of Overall Project Schedule: The overall project schedule shall:

- 1) Provide a complete sequence of construction by activity.
- 2) Show product procurement and delivery dates.
- 3) Include purchase lead time and delivery schedule for major equipment.
- 4) Show the following information for Shop Drawings, project data, and samples:
 - a) Submittal dates.
 - b) Dates review copies of submittals will be required.

- 5) Show decision dates for selection of finishes.

c. Sub-Schedules

- 1) The Contractor shall provide separate subschedules showing submittals, review times, procurement schedules, and delivery days.
- 2) The Contractor shall provide subschedules to define critical portions of the overall project schedule.

d. Updating Overall Project Schedules

- 1) Changes: Show all changes occurring since previous submission of the updated schedule.
- 2) Progress: Indicate progress of each activity and show completion dates.
- 3) Other Items:
 - a) Include major changes in scope.
 - b) Include activities modified since previous updating.
 - c) Include revised projections due to changes.
 - d) Include other identifiable changes.

e. Distribution of Overall Project Schedules

- 1) Reviewed Schedules: The Contractor shall distribute copies of the reviewed schedules to:
 - a) Job site file
 - b) Subcontractors
 - c) Other concerned parties.
- 2) Instructions to Recipients: Instruct subcontractors to report all inability to comply with the Schedule, and provide an explanation with suggested remedies.

f. Failure to Submit Required Overall Project Schedules

- 1) Partial or final pay requests will not be processed unless an acceptable and updated overall project schedule has been submitted as specified herein.

2.2 TWO-WEEK LOOK-AHEAD WORK SCHEDULES

- a. Submittal of Two-Week Work Schedule: The two-week work schedules shall be submitted by no later than the close of business each Friday, with copies to the Owner and the Owner's Representative (*email or delivery of hard copies*).
- b. Form and Content of Two-Week Work Schedule: The two-week work schedules shall:
 - 1) Be prepared on 8½ x 11 paper or 11x17 paper.
 - 2) Identify the work crew & foreman (as applicable) and the location and type of work the crew will be doing each day.
 - 3) Identify each subcontractor (subcontractor name & contact person), as well as the location and type of work the subcontractor will be doing each day.
 - 4) Include proposed notification dates of any interruptions of service or other work for which the Contract Documents require the Contractor to issue notifications. Failure to include notification dates will not relieve the Contractor of responsibility for such notifications.
 - 5) Where the project includes multiple bid schedules, the two-week work schedules shall address work under each schedule and area separately.
- c. Failure to Submit Two-Week Work Schedules
 - 1) If the Contractor fails to submit the required Two-Week Look-Ahead Work Schedules as outlined herein, the Owner, at his option, may issue a Stop Work Order on the project until the required schedules are submitted and approved by the Owner.
 - 2) The Contractor shall not be entitled to any additional contract time or additional compensation for any such delays due to work stoppages resulting from his failure to submit the required work schedules.

PART 3: EXECUTION

None

PART 4: SPECIAL PROVISIONS

None.

SECTION 01350
COMMON PRODUCT REQUIREMENTS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes several product requirements common to most products.
- b. This section defines the minimum requirements of these common traits. The requirements specified herein apply to all products furnished under the Contract except where modified in other sections or otherwise recommended by the manufacturer.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) Manufacturer's certification that all materials and products which will come in contact with potable water meet the requirements of NSF 61 and the specifications contained herein.

PART 2: PRODUCTS

2.1 GENERAL

- a. Whenever any material, article, device, product, or fixture is indicated or specified by patent or proprietary name, by name of manufacturer, or by catalog number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the material or process desired. This procedure is not to be construed as eliminating from competition other products of equal or better quality by other manufacturers where fully suitable in design, and shall be deemed to be followed by the words "or approved equal" unless otherwise indicated in the specifications, on the drawings or by City standards. The decision relative to equivalency shall be by the Owner's Representative and Owner, and shall be final.

2.2 MATERIALS IN CONTACT WITH POTABLE WATER

- a. All materials or products specified in these Contract Documents or required to complete the work which will come in contact with or which will be used on material or products which will come in contact with potable water shall conform to the requirements of OAR 333-061-0087, Product Acceptability Criteria.
- b. All materials or products as specified above shall meet the requirements of the National Sanitation Foundation (NSF) Standard 61, Drinking Water System Components - Health Effects, or equivalent approved by Oregon Drinking Water Services (ie. Oregon Health Authority, Drinking Water Services).
- c. Whenever any material or product is indicated or specified by patent or proprietary name, name of manufacturer or model number, such specification is used for the purpose of establishing a standard of quality and facilitating the description of the material or process

desired. Such specification of a particular product shall not be construed as acceptability under the above listed criteria. It shall be the Contractor's responsibility to provide certification as required above or provide an equivalent quality product for which certification can be provided.

- d. Any material or product installed without certification that it conforms to requirements as specified above shall be removed and replaced by the Contractor at no additional cost to the Owner.

2.3 GALVANIZING (HOT-DIP GALVANIZED)

- a. Where galvanized steel is indicated in these Specifications or shown on the drawings, this shall refer to hot-dip galvanizing with 2.0 oz/ft² surface (*unless otherwise specified*) and conform to ASTM Specifications for respective classes of materials as follows:

- 1) ASTM A-123 Specifications covering the protective zinc coatings applied on products fabricated from rolled, pressed and forged steel shapes, plates, bars and strip, 1/8-inch thick and heavier, by dipping the articles in a molten bath of zinc.
NOTE: The zinc coating on the materials covered by these specifications is too heavy to permit bending and other severe fabrication of the galvanized article without seriously damaging the coating.
- 2) ASTM A-386 Specifications covering zinc coating applied by the hot-dip process on assembled steel products such as steel windows and other light fabricated articles.

2.4 DIS-SIMILAR METALS INSULATION

- a. When two different (dissimilar) metals are in contact, insulating gaskets and other insulating materials shall be provided as required to provide corrosion protection and avoid galvanic interaction (corrosion) between the dissimilar metals. This includes addressing situations where two pieces of the same material are connected with a fastener or bolt made of a dissimilar material.
- b. Flange insulation kits or insulation couplings shall be furnished to provide dielectric protection from electrolytic corrosion at all points where piping of dissimilar metals are joined. Unless otherwise required for the application, gasket kits and/or couplings shall be designed for use in water piping with hydrostatic pressure up to 300 psi and temperatures up to 225°F. Insulation kits and/or insulating couplings shall be provided with an inert, non-conductive, material and provided with sufficient separation between dissimilar metals to prevent "bridging".

2.5 ANCHOR BOLTS AND INSERTS

- a. Unless post installation anchor bolts are specified/noted on the drawings, or proposed by the Contractor & approved by the Owner's representative, anchor bolts and inserts for anchor bolts shall be of types placed before the concrete is poured. All anchor bolts and nuts installed in underwater locations and for equipment exposed to the weather shall be Type 316 stainless steel, unless otherwise noted on the drawings or specifications for specific locations & applications. All others shall be Type 304 stainless steel.

- b. If anchor bolt configurations are proposed which are different from the manufacturer's cast-in-place recommendations or for equipment mounted with expansion anchors, or if drilled & epoxied threaded anchor rods are proposed based on the options listed below, calculations shall be provided (*by a licensed structural engineer retained by the Contractor or the equipment supplier*) showing that the proposed anchor bolt system is structurally equivalent to the standard J anchor bolts recommended/required by the manufacturer (*or shown on the drawings*), for the specific equipment being provided.
- c. Well in advance of pouring concrete the contractor shall submit for the Owner's Representative's approval, drawings, information and specifications showing that the anchor bolt alternatives and documentation will meet the requirements of the work.
- d. Anchor Bolt Diameter. The diameter and length of anchor bolts shall be as shown on the drawings or as recommended by the equipment or machinery manufacturer, whichever is more stringent. In no case shall anchor bolts be more than 1/8-inch smaller than the anchor bolt holes provided by the manufacturer of the equipment or machinery.
- e. Epoxy Threaded Anchor Rod Option. If drilled & epoxied threaded anchor rods are proposed by the Contractor or the equipment supplier in place of standard cast-in-place anchor bolts, the size and embed depth of the stainless steel threaded rods shall meet or exceed the size and embed depth of the standard anchor bolts recommended/required by the manufacturer (*or shown on the drawings*), for the specific equipment being provided, and based on the following.
 - 1) Epoxy adhesive for use with the 304 stainless steel threaded anchor rods shall be Simpson SET-3G High-Strength Epoxy Adhesive.
 - 2) The size of the hole in the concrete shall be in conformance with the manufacturer's recommendations (*typically 1/8" larger than the threaded rod diameter*).
 - 3) Installation shall fully conform with the manufacturer's recommendations, including hole cleaning & epoxy installation.
 - 4) Contractor shall be responsible for coordinating all inspections and special inspections required for such drilled & epoxied threaded anchor rods by applicable building codes.
 - 5) Contractor shall ensure that anchor bolts are not disturbed until epoxy is fully cured (*see SET-3G cure schedule, typically varies from 24 to 72 hours, depending on concrete temperature*), by either do not allowing entry into the wetwell for the entire cure time, OR providing secure anchored covers over the anchor bolts to ensure that they are not accidentally disturbed.
- f. Where permitted by the Owner's Representative, the Contractor may use wedge type expanding anchors placed in predrilled holes.
- g. Double Nuts. A minimum of two nuts and one washer of the same material as the bolt shall be furnished with each bolt, with both nuts being fully engaged on the anchor bolt threads.
- h. Self drilling anchors and powder activated fasteners will not be permitted except where specified or shown on the drawings.

PART 3: EXECUTION

3.1 DELIVERY, HANDLING AND STORAGE OF PRODUCTS, MATERIALS, EQUIPMENT AND ARTICLES

- a. Unless otherwise specified in the individual sections, the Contractor shall deliver, handle and store materials and equipment in accordance with the requirements of the manufacturer and the following:
 - 1) Delivered materials and equipment shall be in the manufacturer's original, unopened packaging with labels intact and legible.
 - 2) Delivered materials should be in sufficient quantity to allow continuity of work.
 - 3) The delivered materials and equipment shall be stored on clean raised platforms in conformance with the manufacturer's requirements.
 - 4) The materials and equipment shall be protected from the weather, dust, mud, oil, moisture and other elements that are detrimental to the material or equipment.
 - 5) If stored outside, materials and equipment shall be covered with tarpaulins and adequate drainage shall be provided.
 - 6) Materials and equipment shall be protected against damage by construction traffic.
 - 7) Materials and equipment that are damaged or do not conform to the Specifications shall be removed immediately from the project site.
 - 8) Storage of materials, equipment and incidentals shall comply with all Local, State and Federal ordinances, regulations and requirements.
 - 9) Emulsions and paints shall be stored in temperatures above 45°F.
- b. Materials, equipment and articles to be incorporated into the work shall be stored so as to facilitate inspection and in such manner as to ensure the preservation of their quality and fitness for the work. Stocked materials, even though approved before storage, shall be subject to test and shall meet requirements of the Specifications at the time they are to be used in the work.
- c. Where construction is in roads, streets, etc., that portion of the right-of-way not required for public travel may be used for storage purposes, unless otherwise prohibited (by the drawings, contract documents or agency with jurisdiction), and for placing of the Contractor's plant and equipment. Any other additional space required for construction facilities or storage of materials and equipment shall be provided by the Contractor at his expense.

- d. The Contractor will confine his equipment, the storage of materials and equipment and the operations of his workmen to areas permitted by law, ordinances, permits or the requirements of the Contract Documents, and shall not unreasonably encumber the premises with materials or equipment.

3.2 SHOP PAINTING

- a. Where materials or equipment is not provided with a corrosion resistant factory finish coat compatible with the conditions of service, shop painting of ferrous surfaces shall be as follows unless otherwise indicated in the individual sections. Unless otherwise specifically required in the individual sections, this requirement shall not be construed as eliminating or modifying a factory finish coat that is designed for the conditions of service for which the material or equipment is provided.
 - 1) All surfaces shall be thoroughly cleaned of dirt, grease, oil, rust scale or other injurious substances. All metal surfaces shall be sandblasted in accordance with SSPC-SP10, Near-White Blast Cleaning.
 - 2) All ferrous surfaces that will be partially or wholly submerged shall receive a shop coat of polyamide-cured epoxy resin primer and an epoxy finish coat. All non-galvanized ferrous metal surfaces that will be above water surfaces shall receive a shop coat of a universally compatible primer and an epoxy finish coat.
- b. Surfaces which are to be embedded in concrete shall be cleaned but shall not be painted.

PART 4: SPECIAL PROVISIONS

None.

SECTION 01410
LABORATORY SERVICES

PART 1: GENERAL

1.1 SCOPE

- a. The Owner or Owner's Representative will retain an independent testing laboratory for conducting field and laboratory tests as outlined herein to verify the Contractor's compliance with the Specifications.
- b. The testing laboratory will furnish all labor, materials, equipment and services necessary to perform concrete tests, compaction tests of pavement bases and backfill, sieve analyses of aggregate materials, approve material and review the design of bituminous and concrete plant mixes, and conduct other tests as specified below and in other sections as directed.

1.2 CONTRACTOR'S RESPONSIBILITY

- a. Testing of materials or equipment for compliance with various national or technical society standards and ordinarily performed by manufacturers, and shop and field tests of equipment are not included under this section but shall be performed by the Contractor or his supplier as specified elsewhere.
- b. Any test required by the Owner shall not relieve the Contractor from the responsibility of supplying certificates from manufacturers or suppliers to demonstrate compliance with the Specifications.

1.3 QUALIFICATIONS

- a. The laboratory shall be a recognized and independent commercial laboratory with experience in conducting the required tests.

1.4 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents.
- b. Mix Designs: The laboratory shall review and test mix designs submitted by the Contractor. Approved mix designs shall include sieve analyses and suppliers' certificates for materials incorporated in the mix.
- c. Distribution: One copy of all certified test reports and mix designs shall be distributed as follows:
 - 1) Owner
 - 2) Westech Engineering, Inc.
3841 Fairview Industrial Drive SE, Suite 100
Salem, OR 97302-1192
 - 3) Owner's Field Representative
 - 4) Contractor

1.5 SUPPLEMENTARY AND OTHER TESTING

- a. Nothing shall restrict the Contractor from conducting additional material or field tests he may require. However, should the Contractor, at any time, desire the Owner to consider the results of such testing, test reports shall be certified by an independent testing laboratory acceptable to the Owner. Any testing of this nature shall be conducted at the Contractor's expense.

PART 2: PRODUCTS

- 2.1 TESTS. Contractor shall coordinate and provide for any and all testing specified herein, listed on the drawings or in the individual specifications sections. Tests shall include but not be limited to the following.

- a. Aggregates, Bedding Material and Granular Backfill: For each type of material, the laboratory shall perform an ASTM C-136 sieve and screen analysis to determine whether the material meets the Specifications noted in the individual sections (*note that the sieve analysis for granular backfill or granular baserock must also include screens to determine the percentage passing the #40 sieve and the #200 sieve*). Retests shall be performed until the Specifications are met and each time the source of material is changed.
- b. Selected Backfill: At the discretion of the Owner's Representative, but in no case more than one test for each 1,000 c.y. of each material source or portion thereof, the laboratory shall perform an ASTM C-136 sieve and screen analysis to determine whether the material is suitable for backfilling purposes.
- c. Mix Designs: For each type of controlled density fill, concrete and asphalt, the laboratory shall perform and approve the necessary mix design and shall perform and approve redesign if there is a change in source of materials. The asphalt design shall be made in accordance with ASTM D-1559, the Marshall Method of mix design or other Owner's Representative approved method.
- d. Compaction Tests: For each type of backfill material, the laboratory shall determine the moisture density curve according to AASHTO T-180 (Modified Proctor/ ASTM D1557). Using ASTM D-2922 test methods, the laboratory shall determine the density of in-place backfill. Retests shall be performed if the compaction requirements stated in the individual sections are not met.
- e. Asphalt and Concrete Quality Control Testing: The laboratory shall perform tests as indicated in these Contract Documents.
- f. Miscellaneous Tests: The laboratory shall perform all other tests requested in the individual sections of the Specifications.
- g. Retest: Retesting required because of failure to meet specification shall be at Contractor's expense.

2.2 PLANT INSPECTIONS

- a. The laboratory may inspect and certify asphalt and concrete plants as indicated in these Contract Documents.

2.3 EQUIPMENT

- a. The laboratory shall provide all necessary equipment to extract and store samples and perform the required tests.

PART 3: EXECUTION

3.1 MATERIAL TESTS

- a. The laboratory shall conduct tests on materials and in locations as specified or as directed by the Owner's Representative.
- b. All tests shall be performed in accordance with the proper test methods mentioned above and in the individual sections. Results shall be compared to the required values included in the individual sections.

3.2 MIXING PLANT CONTROL

- a. The Plant laboratory shall provide mix designs and control mixing plant production for conformance to product specifications as specified or as directed by the Owner's Representative.

PART 4: SPECIAL PROVISIONS

None.

SECTION 01530
SETTLEMENT MONITORING

PART 1: GENERAL

1.1 SCOPE

- a. The Contractor shall be responsible to conduct a settlement monitoring program for the select elements of work identified in this section. The primary purpose of the monitoring plan is to observe settlement or movement of the existing building floors in the excavated areas for the installation of the new DAF/Irrigation Pump Station and the new final effluent pipeline near the existing buildings on lagoon cell 4 dike.
- b. Monitoring of defined settlement points shall be conducted at the start of, and throughout, the construction period. Regular measurements and observations are designed to quantify settlement magnitudes and to permit timely implementation of successful mitigation measures to avoid damage or adverse impact to the existing facilities should it become necessary.
- c. Construction activities that shall receive special attention include the installation of excavation support systems and excavations in proximity to the existing building foundations that extending below the bearing surface of the footing.

1.2 RELATED SECTIONS

- a. Section 02160 – Excavation Support, Protection, and Cofferd Damming
- b. Section 02201 – Excavation, Fills and Subgrade Preparation

1.3 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents.
- b. The Settlement Monitoring Plan shall be submitted 60 days prior to commencement of the work in the areas noted above. The submittal information shall include the following:
 - 1) Identification of established reference benchmarks and project benchmarks as described in this section.
 - 2) The name, address and telephone of the licensed surveyor contracted to perform the surveying work.
 - 3) Survey procedures to be utilized in the monitoring program including the type of equipment to be used and the approach and method of recording readings.
 - 4) The procedure for reporting results to the Engineer, as well as the format of those reports (ie. summarizing spreadsheet).

PART 2: PRODUCTS

2.1 LICENSED SURVEYOR

- a. The Contractor shall retain the services of a Registered Professional Surveyor licensed in the State of Oregon to perform the survey work described in this section.

2.2 BENCHMARKS

- a. A reference benchmark shall be established near the two structures in an area that will not be disturbed by construction activities.
- b. Additional reference benchmarks shall be established as required by the Contractor to complete the monitoring measurements as described.

2.3 SETTLEMENT MONITORING POINTS

- a. A total of six (6) monitoring benchmarks shall be established for the purposes of monitoring settlement.
- b. Benchmarks shall be established with the use of P.K. nails or other similarly durable reference points embedded into the concrete surfaces of the floor slab along the east walls of the two buildings. Three benchmarks, shall be equally spaced along the east walls of the each building. Nails shall be drilled and secured with epoxy as required to establish durable reference points.

PART 3: EXECUTION

3.1 SETTLEMENT MONITORING

- a. The Contractor shall implement and maintain its approved Settlement Monitoring Plan at the start of the construction period and continuing until final completion unless terminated by mutual consent of the Engineer and Contractor.

3.2 OPEN EXCAVATION

- a. It is imperative that the duration of the open excavations be minimized to the greatest extent possible.

3.3 SETTLEMENT MONITORING PLAN IMPLEMENTATION

- a. The Contractor's monitoring plan shall include performing precise surveys using optical or laser survey methods to determine vertical and horizontal displacements.
- b. Vertical measurements shall be accurate to 0.005 feet minimum.
- c. The settlement points shall have an identification number and elevation as appropriate.
- d. The settlement monitoring points shall be surveyed prior to the commencement of excavation. The submittal of this initial data set to the Owner is a prerequisite to the commencement of excavation.

- e. Measurements of the settlement monitoring points shall be performed once after the midpoint of the vertical excavation is reached, once at the time the maximum excavation depth is reached when the shoring system is fully deployed, once after the removal of the shoring system and once weekly for a period of three weeks after the installation work and surrounding backfill is complete. Thereafter additional readings shall be at the request of the Owner's Representative. The Contractor shall be reimbursed by the Owner for the documented cost of all readings made at the request of the Owner's Representative beyond the three week period.
- f. The Contractor may, at their sole discretion, conduct additional settlement monitoring. If during any measurement interval, movements exceeding 0.06 inch are recorded, immediately notify the Engineer.
- g. The Contractor shall maintain logs and calculations for the collected survey data. Such information shall be made available upon request of the Engineer to review within 24 hours after collection for each measurement interval. The Contractor shall provide copies of such data to the Engineer as requested.

The Contractor shall monitor the excavation support and protection systems daily during excavation progress and for as long as the excavation remains open. Promptly report and correct bulges, breakage or other evidence of movement to ensure that the excavation support and protection systems remain stable. The Contractor shall take prompt remedial action should movement in the excavation support system exceed the limits specified in the Contractor's prepared shoring and excavation support submittal as specified in Section 02160—Excavation Support, Protection, and Cofferdamming.

- h. The Contractor shall notify their retained engineer immediately if during construction, subsurface conditions are different from those utilized in the design of the excavation support and protection system.

3.4 PROTECTION OF EXISTING FACILITIES

- a. Excessive settlement of existing structures as determined by the Engineer and as defined in Section 02160—Excavation Support, Protection, and Cofferdamming may provide the basis for the Owner to suspend the Work or any portion thereof until the source of settlement and remedial actions can be determined.

PART 4: SPECIAL PROVISIONS

None.

SECTION 01568
EROSION AND POLLUTION CONTROL

PART 1: GENERAL

1.1 SCOPE

- a. It shall be the responsibility of the Contractor to prevent pollution of air, water and soil resulting from his operations.
- b. The Contractor shall perform work required to prevent soil from eroding or otherwise entering onto all paved areas and into natural watercourses, ditches, and public sewer systems and to prevent dust attributable to his operations from entering the atmosphere. This work shall be in accordance with Federal, State and Local codes.
- c. Water containing suspended material from any part of the Contractor's operations shall be clarified before discharging to drains or streams.
- d. Contractor shall procure and conform to all Federal, State and local permit requirements, including but not limited to DEQ 1200-C permit requirements.
- e. The Owner will obtain the DEQ 1200-C permit. The Contractor shall transfer (into Contractor's name) the 1200-C permit and the responsibility for erosion control inspection under the permit prior to issuance of the Notice to Proceed. The Contractor shall notify the Owner's Representative in writing when the transfer is complete. Issuance of the Notice to Proceed prior to completion of this transfer shall not relieve the Contractor of the responsibility of immediately completing any required transfer applications and paying any required fees.
- f. Noise pollution shall be minimized through the use of proper mufflers on all construction equipment.
- g. The Contractor shall seed and mulch all disturbed areas or areas damaged by his operations.

1.2 CONSTRUCTION SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include, but not be limited to, the following:
 - 1) Submittals for Review. Submittals shall include but not limited to the following:
 - a) If the Contractor plans to provide alternate erosion control measures from those shown & noted on the drawings, or if additional information or submittals is required by any erosion control permit associated with the project, complete erosion control plans, details, and maintenance procedures shall be submitted for review and reference by the Owner's Representative and applicable agencies.

PART 2: PRODUCTS

2.1 GENERAL

- a. Dust palliatives (additives) shall conform to OSSC (ODOT/APWA) Section 00340, Watering.
- b. Other erosion control structures and products as shown on the drawings.

2.2 MULCHING MATERIAL

- a. When used, hydromulch shall be applied with grass seed at a rate of 2000 lbs. per acre between April 30 and June 10 or between September 1 and October 1, unless otherwise specified on the drawings or by erosion control permits. On slopes steeper than 10 percent, hydroseed and mulch shall be applied with a bonding agent (tackifier). Application rate and methodology to be in accordance with seed supplier recommendations.
- b. Mulch shall be either hydromulch or finely chopped fescue or rygrass mulch conforming with OSSC (ODOT/APWA) Section 01030.15
 - 1) **CEREAL GRAIN STRAW (*wheat or similar*) IS NOT AN ACCEPTABLE SUBSTITUTE** without specific written approval.
- c. When use is allowed by jurisdiction in lieu of hydroseed/hydromulch, dry, loose, weed free fescue or rygrass used as mulch shall be applied at a rate of 4000 lbs. per acre (*double the hydromulch application requirement*). Anchor by working in by hand or with equipment (rollers, cleat trackers, etc.). Mulch shall be spread uniformly immediately following seeding, without clumps.

PART 3: EXECUTION

3.1 CLEANUP OF STREETS, SIDEWALKS AND DRIVEWAYS

- a. Hard surfaced streets, haul roads and (if directed by the Owner's Representative) detours and bypass roads shall be swept by automatic self-contained sweepers as required to keep them free of dirt or debris.
- b. Excessive dirt on pavements shall be removed by means of hand shoveling or appropriate mechanical equipment and the area swept as directed above.
- c. Sidewalks and driveways shall be cleaned by means of shovels and handbrooms or appropriate mechanical equipment.
- d. Dust on unsurfaced streets or parking areas and any remaining dust on surfaced streets shall be controlled with an approved dust palliative as directed by the Owner's Representative.
- e. The Contractor shall comply with the above requirements on a daily basis. If the Contractor fails to perform the above work in a satisfactory manner, the Owner's Representative may stop all work, except cleanup operations, until the Contractor has satisfactorily complied with the above requirement.

3.2 WATER DISCHARGED TO DRAINS OR STREAMS

- a. The Contractor shall construct and maintain filters, sedimentation traps, or stilling basins with overflows to clarify waters containing suspended materials from fill areas, excavations, deep wells, well points and disposal sites before discharging to drains or streams.

PART 4: SPECIAL PROVISIONS

None.

**SECTION 01580
PROJECT SIGN**

PART 1: GENERAL

1.1 SCOPE

- a. This Section includes the requirements for funding agency project signs.
- b. One project construction signboard shall be provided and installed by the Contractor.
- c. Design: Sign poster shall be provided furnished by the contractor and shall conform be accordance with the USDA guidelines for the project sign located in the front-end contract documents. Contractor shall glue poster to signboard.

PART 2: PRODUCT, DELIVERY, STORAGE AND HANDLING

- a. Install signboard and poster before any construction is started. Maintain signboard and poster for the duration of construction.
- b. Remove signboard and poster within ten (10) days of Final Certificate of Payment.
 - 1) Fill all postholes.
 - 2) Finish site area as directed by the Owner's Representative.
- c. Ownership
 - 1) Upon removal of construction signboard and poster, they shall belong to the Owner.
- d. Material Specifications
 - 1) Signboard: ¾ inch plywood (size per funding agency guidelines), grade B-B high density, exterior, good two sides, conforming to PS-1.
 - 2) Supports: Treated Damage free (D.F.) posts. Provide length as necessary for a one-foot clearance at grade and three-foot embedment of posts.
 - 3) Installation: Locate the sign as directed by the Engineer/Owners Representative.

PART 3: EXECUTION

None.

PART 4: SPECIAL PROVISIONS

None.

SECTION 01610
AMERICAN IRON & STEEL REQUIREMENTS

PART 1: GENERAL

1.1 SCOPE

- a. This Section summarizes the requirements for use of American Iron & Steel, as required by the funding agencies and/or other agencies with jurisdiction.
- b. Compliance with the requirements of American Iron & Steel (AIS) provisions shall be entirely the responsibility of the Bidder/Contractor and his subcontractor / supplier / construction team, whether included in this section or summarized in other portions of the Contract Documents. Failure to account for the AIS requirements during bidding will not be grounds for a contract change order.

PART 2: PRODUCTS

None.

PART 3: EXECUTION

3.1 GENERAL

- a. This project is subject to what is commonly known as “American Iron and Steel,” which requires all of the iron and steel products used in the project to be produced in the United States (“American Iron and Steel Requirement”), including iron and steel products to be provided by the Contractor pursuant to the Agreement. Each manufacturer is required to provide documentation certifying compliance with these requirements, listing each item for which such certification is required.
- b. Upon project Completion, the Contractor shall also certify that the project conforms to the American Iron and Steel Requirements. This certification is included in the Written Warranty & Certification For Final Payment Letter described in Section 01750.
- c. Documentation required to demonstrate compliance with AIS for any applicable equipment or material, shall be provided in together and in conjunction with construction submittals provided in accordance with the requirements of Section 01300.
- d. Waiver Claims. Copies of a waiver approved by EPA must be provided with the submittal for any equipment or material which the manufacturer claims is exempt from AIS requirements due to such a waiver. For reference, waivers to AIS requirements for SRF funded projects must be granted by the US EPA.

3.2 SAMPLE CERTIFICATION LETTERS FOR MANUFACTURERS

- a. The following are sample certification letters based on the format provided by USEPA in Appendix 5 of their March 20, 2014 Memorandum on the implementation of the American Iron and Steel requirements (available on-line at “<https://www.epa.gov/sites/production/files/2015-09/documents/ais-final-guidance-3-20-14.pdf>”). Contractor shall provide a written certification letter, from the manufacturer, and

submitted to the Owner's Representative with any construction submittals which include material, equipment or components which are required to comply with the AIS requirements.

b. AIS Standard Certification Letter. The following information is provided as a sample letter of certification for AIS compliance. The letter shall:

- be provided on company letterhead from the manufacturer, and
- reference the specific project for which the certification is being submitted, and
- list each item for which the certification is being submitted, and
- list the location (*city & state*) where each referenced manufacturing process took place (*not the location of the company headquarters*), and
- (*if the letter references material provided by another manufacturer*) include copies of the AIS step certification letter from each such manufacturer, and
- be signed by the manufacturer's representative.

If the manufacturer's certification letter references step certifications prepared by other manufacturers, copies of those supporting step certifications shall be provided with this letter.

Date
Company Name
Company Address
City, State Zip

Subject: American Iron and Steel Certification for _____ Project

I, <company representative>, certify that the following products and/or materials <shipped/provided> to the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. Xxxx
2. Xxxx
3. Xxxx

Such process took place at the following location(s):

_____ (*city & state where manufacturing facility located*)

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

- c. AIS Step Certification Letter. The following information is provided as a sample letter of step certification for AIS compliance. The letter shall:
- be provided on company letterhead from the manufacturer, and
 - list each item for which the step certification is being submitted.
 - list the location where each referenced manufacturing process took place

Date

Company Name

Company Address

City, State Zip

Subject: American Iron and Steel Step Certification for Project (XXXXXXXXXX)

I, <company representative>, certify that the <melting, bending, coating, galvanizing, cutting, etc.> process for <manufacturing or fabricating> the following products and/or materials shipped or provided for the subject project is in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. Xxxx
2. Xxxx
3. Xxxx

Such process took place at the following location(s):

_____*(city & state where manufacturing facility located)*

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

3.3 DE-MINIMIS EXEMPTION

- a. The USEPA issued a "De Minimis Waiver", effective April 15, 2014, which covers "de minimis incidental components of eligible water infrastructure projects." A copy of this waiver is available for review on-line at ["https://www.epa.gov/sites/production/files/2015-09/documents/deminimis-waiver-04-15-14.pdf"](https://www.epa.gov/sites/production/files/2015-09/documents/deminimis-waiver-04-15-14.pdf). This is commonly known as the "de-minimis exemption."
- b. This De Minimis Waiver "*permits the use of products when they occur in de minimis incidental components of such projects funded by the Act that may otherwise be prohibited under section 436(a). Funds used for such de minimis incidental components cumulatively may comprise no more than a total of 5 percent of the total cost of the materials used in and incorporated into a project; the cost of an individual item may not exceed 1 percent of the total cost of the materials used in and incorporated into a project.*"
- c. The 2014 De Minimis Waiver includes the following language. "*Examples of incidental components could include small washers, screws, fasteners (i.e., nuts and bolts),*

miscellaneous wire, corner bead, ancillary tube, etc. Examples of items that are clearly not incidental include significant process fittings (i.e., tees, elbows, flanges, and brackets), distribution system fittings and valves, force main valves, pipes for sewer collection and/or water distribution, treatment and storage tanks, large structural support structures, etc.”

- d. Any non-domestic materials used under the de-minimus exemption must be logged and tracked using the De Minimis Waiver Tracking Log worksheet included under the “Safe Drinking Water Revolving Loan Fund (SDWRLF) Documents and Forms” or the “Clean Water Revolving Loan Fund (CWRLF) Documents and Forms” section of the project manual.
- e. **Current De-Minimis Log Required with Each Pay Request.**
 - 1) A current copy of the de-minimus tracking log must be submitted by the Contractor with each application for payment.
 - 2) The de-minimus tracking log must include all items and materials which were submitted on without the required AIS certifications, as well as other items and material which the Contractor or his suppliers have indicated were to be included on the AIS de-minimus tracking log.

3.4 **FAILURE TO PROVIDE COMPLETE & COMPREHENSIVE DE-MINIMIS LOG**

- a. If the Contractor fails to provide a complete and comprehensive de-minimus tracking log with any pay request (*as required above*), the Owner’s Representative may refuse to approve or allow the use of any additional items or material for which AIS certification is required, until a complete and comprehensive de-minimus tracking log is provided.
- b. Any such refusal by the Owner’s Representative (*due to failure to provide a complete and comprehensive de-minimus tracking log*) will not entitle the Contractor to an increase in contract time or an increase in the contract price.

3.5 **APPROVED NATIONAL WAIVERS**

- a. The US EPA maintains a website which includes copies of all approved national waivers.
<https://www.epa.gov/cwsrf/american-iron-and-steel-requirement-approved-national-waivers-0>

PART 4: SPECIAL PROVISIONS

None.

**SECTION 01650
FACILITY STARTUP**

PART 1: GENERAL

1.1 FACILITY STARTUP

- a. Commission all systems and equipment to verify performance, function, and correct operation by performing procedures to activate, startup, adjust, test, and demonstrate that the work is in operating order in accordance with these general requirements of this Section and the detailed requirements of the technical sections under the system or equipment specified.

To ensure that the work is ready for full-time operation the procedures include verification, balancing, calibration, witness testing, documentation, inspection by equipment manufacturers, and operator training where specified.

- b. Notification: Notify the Owner five (5) days prior to starting each system or piece of equipment. Notify the Owner fourteen (14) days in advance of the full facility startup.
- c. Coordination: During the startup period, coordinate the operation of the facility with Owner, subcontractors, Owner's operators, and manufacturer's representatives.
- d. Furnish test equipment, measuring devices and supplies required to conduct tests.
- e. Maintain the equipment until final acceptance. Provide all lubricants, chemicals, and electricity necessary until final acceptance.
- f. Furnish all expendable supplies, gas, diesel fuel, water, etc., required for startup, demonstration and testing and dispose of all waste or used supplies, water, etc.

1.2 SUBMITTALS

- a. Startup Plan, Forms, and Schedule: Prepare a facility startup plan and schedule. The plan shall include test methods and procedures and sample forms for recording test data. It shall clearly show how start-up of the "Liquid Stream Process units" will be started up within the required time.
- b. Submit documentation of tests, balancing reports, and the like.

1.3 INITIAL STARTUP AND OPERATION OF FACILITIES

- a. The following listing is a general sequence of startup activity steps to be used in placing facility systems into operation. The Contractor shall also review the suggested sequence of operations presented on the drawings and the startup requirements for each individual specification section.
 - 1) Perform initial lubrication of equipment and have manufacturers check and adjust equipment. Provide all subsequent lubrication and maintenance, and such staff as required for test operation until the Owner assumes equipment maintenance responsibility after Step 14 below.

- 2) Perform satisfactory testing of electrical work required prior to energizing of the electrical system.
- 3) After completion of Step 2, perform satisfactory electrical testing required after energizing of the electrical system.
- 4) Complete calibration of instruments.
- 5) Satisfactorily complete system verification of instrumentation work.
- 6) After completion of Steps 1 and 3, perform a rotational test of equipment and correct backward rotating drives.
- 7) After completion of Steps 5 and 6, test operate the equipment by manually initiating the operation. Where manual operation bypasses alarm or safety monitoring, provide continuous supervision of such parameters. Perform this step using water in lieu of chemicals or other process liquids. Use dry air or nitrogen in lieu of hazardous gases.
- 8) Concurrent with Step 7, perform instrumentation and control testing and adjustments as related to the equipment being tested.
- 9) Concurrent with Step 7 and where possible at this stage of startup, complete the performance testing specified for the equipment.
- 10) Concurrent with Step 7, perform adjustments of the electrical work as related to the equipment being tested.
- 11) Repeat Steps 1 through 10 as required for other equipment items and plant systems until all plant process components and utility systems are ready for total plant operation. It may be necessary for the Contractor to put portions of the newly constructed facility in service before constructing other portions of the facility or completing the Work as a whole. See the suggested sequence of operations on the drawings.
- 12) Notify the Owner and the Engineer 15 days before total plant operation is to occur so that the Owner may make arrangements for full time operation.
- 13) Upon completion of all the above steps, the facility shall be started up and operated on a complete full time basis beginning on the indicated date. For three consecutive days beginning with the start-up day, the Contractor shall have at the site, during the day shift, a mechanic, an electrician and an instrumentation representative. Representatives of manufacturers of critical equipment shall also be present for as needed or as required elsewhere in the specifications. The Contractor shall also provide these personnel, on a 24-hour per day, "on call" basis, if necessary, to adjust, repair, and correct deficiencies as required to keep the facilities in continuous operation for a period of 30 days. The Contractor shall train the operators in the proper operation and the control of the new facilities. The Contractor shall also furnish all such mechanical and electrical workers as

required to make adjustments to and perform all required maintenance for the operating equipment until the end of the 30-day initial operation period. Maintenance of operating equipment shall include lubrication, adjustments, replacements, and modifications as required.

- 14) After successful completion of the 30-day initial operation period, the Owner will take over maintenance duties as well as operation and will begin to provide and pay for lubricants.
- 15) Following the commencement of Step 13, satisfactorily complete equipment performance testing, electrical testing and adjustments, and instrumentation/control testing and adjustments to the extent that such testing and adjustments could not be made prior to full plant operation.
- 16) Complete the documentation of test, balancing reports, and the like commissioning for submittal during the startup process and before acceptance.

1.4 MANUFACTURER'S FIELD SERVICE AND AFFIDAVITS

- a. Field Service: Where specified, manufacturers of equipment shall provide field service. Field service shall be provided by an authorized factory-trained and qualified manufacturer's representative for the specific equipment. Equipment shall not be considered ready for full time operation until after the manufacturer's representative has checked and adjusted the equipment, and certified by written affidavit that the equipment has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full time operation.
- b. Affidavits: Acceptable affidavits shall be submitted prior to completion of the work.
 - 1) Affidavits shall contain the following specific wording:
"The *[Name of Equipment]* has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full time operation. The installation has been inspected and has been found to be in conformance with our (the manufacturer's) standards and requirements."
 - 2) No amplification, dilution, or modification of this specific wording will be permitted.

1.5 TRAINING

- a. Submit Operation and Maintenance Manuals and Parts List specified in Section 01300. These shall be submitted prior to the completion of construction as required in Section 01300.
- b. Demonstrate the operation, maintenance and safety procedures for all systems and equipment to personnel designated by the Owner.
- c. Provide onsite demonstration of systems and equipment as specified in the equipment specification sections.

PART 2: PRODUCTS

None.

PART 3: EXECUTION

None.

PART 4: SPECIAL PROVISIONS

None.

**SECTION 01705
O&M SUBMITTALS**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes requirements for submittals of operations & maintenance information and manuals.
- b. O&M manuals shall include the following as a minimum, organized and correlated as required under this section.
 - 1) Information required under this section.
 - 2) General project information required by the specifications (*including Contractor's general warranty per Section 01750*),
 - 3) Copies of all final building inspections as applicable.
 - 4) Copies of all final inspections by other agencies with jurisdiction as applicable.
 - 5) Submittal & O&M information for all equipment requiring maintenance, or for which O&M information is required by the specifications.
 - 6) Warranties covering all material and equipment for which manufacturer's warranty is required.
- c. Electrical O&M. Other electrical & controls information shall be provided as required under Division 13 or Division 16 as applicable.

1.2 COORDINATION OF O&M SUBMITTALS

- a. Initial O&M Review Submittal. The Contractor shall submit to the Owner's Representative two (2) paper review copies of the complete O&M manuals for review by the Owner and/or agencies with jurisdiction.
- b. O&M manuals shall be submitted far enough in advance to allow the following requirements to be satisfied.
 - 1) The Contractor shall be responsible for submitting the O&M manuals far enough prior to the end of the Contract Period to allow the Owner's Representative adequate time to review the manuals. The Owner's Representative (*and agencies with jurisdiction*) will review the draft O&M manuals with reasonable promptness for their compliance with the Contract Documents.
 - 2) The Contract provides that the work will not be considered to be substantially complete until required O&M manuals are submitted and accepted by the Owner's Representative.
 - 3) A review copy will be returned to the Contractor for correction and revision. The Contractor shall then resubmit the required number of complete and corrected O&M manuals. If the manual are still incomplete, they may be returned again for revision by the Contractor.
 - 4) Complete revised O&M manuals shall be provided before the Contractor requests final inspection.

- 5) Partial Substantial Completion. If the Owner (*at its sole discretion*) decides to perform a final inspection and/or issue substantial completion prior to receipt of the final approved O&M manuals, the Owner reserves the right to require that any liquidated damages continue to accrue until such time as the final approved O&M manuals are received (*ie. any substantial completion determination will be a partial substantial completion, subject to receipt of final approved O&M manuals*).
- c. Number of Final Paper Copies. After initial review as noted above, the Contractor shall submit to the Owner's Representative four (4) complete paper copies of the final revised O&M manuals (*in addition to pdf versions of the binders*). If additional revisions are required, the Owner's Representative will retain one copy and return the remainder to the Contractor for revision.
- d. Prior to Submitting Information to the Owner's Representative: The Contractor shall carefully review and ensure that all O&M submittals are tailored to the project by highlighting appropriate information and/or deleting or crossing out non-applicable information, and that all options and equipment furnished are indicated or listed.
- e. Oregon DEQ requires that for sewer pump station projects, the operation and maintenance (*O&M*) information is to be submitted to DEQ prior to 50% completion of the project. The Contractor shall be responsible for all work necessary to coordinate submittal of O&M information for all project equipment within this timeframe.

PART 2: PRODUCTS

2.1 COMPLETE MANUALS REQUIRED

- a. Review copies of the O&M manuals shall be complete volumes, organized and indexed for all associated items of equipment to be included in that binder, with labeled colored pages included where items remain to be inserted.
- b. The O&M information for individual equipment items is not to be submitted piecemeal. Where O&M manuals have multiple binders, the different binders (*mechanical, electrical, SCADA, etc.*) can be submitted separately for review, but the binders must be numbered and accompanied by a draft overall index covering all binders.
- c. Placeholders for Pending Information. Since some of the required items may not be available for insertion into the O&M manuals until the end of the project (*ie. final inspection certificates, final startup reports, etc.*), it is acceptable to submit the manuals for initial review prior to these documents being available, although the places where these documents will be inserted is to clearly identified (*by use of labeled colored pages with wording identifying the document to be inserted, or similar method*).
- d. The final O&M manuals will be accepted only if complete, properly identified with Contract Specification Section Numbers and only after revised, where necessary, to conform to the previous review comments by the Owner's Representative's and/or agencies with jurisdiction.

2.2 O&M MANUAL INFORMATION & FORMAT

a. Binder Cover Sheet.

- 1) Each binder shall be provided with a cover sheet (*in the view cover, and as the first page of each volume*), which shall include the following information as a minimum.
 - a) Project name & Location.
 - b) Owner Name.
 - c) Contractor Name.
 - d) Binder or Volume #

b. Table of Contents shall be furnished as summarized below.

- 1) Individual Binder TOC: A detailed Table of Contents (*covering all items in that binder*) shall be provided at the front of each binder.
- 2) Overall TOC: Where multiple binders are required, an overall summary Table of Contents shall be provided (*summarizing the general content of each of the binders*). This TOC shall be inserted behind the individual binder TOC where multiple volumes are provided.

c. Index Tabs / Tab Section TOC.

- 1) Labeled index tabs shall be furnished for all binders containing data for more than one item of equipment. Index tabs shall separate each system or major equipment item.
- 2) Tab Section TOC. Where an equipment tab section for an equipment system includes two or more separate items or discrete system components with separate submittal and/or O&M information, a sub-section “table of contents” shall be provided at the front of the equipment tab section, and sub-tabs shall be provided between the discrete equipment items.

d. Color Copies Required.

- 1) When manufacturer’s literature & O&M information includes text, figures or other information in color (*or when submittals included in the O&M manuals include color*), the contractor shall provide color copies of this information in the O&M manuals.

e. Highlighting and/or Marking.

- 1) All manuals shall be tailored to the project by high lighting appropriate information and/or deleting or crossing out non-applicable information.
- 2) All options furnished shall be indicated, either with a summary sheet at the front of each tab section or on the applicable page in the O&M information.

- f. Binders. A complete manual shall be provided for each site in 3-ring binder(s) with index tabs between all sections, as well as between each equipment system or major equipment item.
- 1) Binders shall be locking D-Ring, view style binders, with exterior view pockets on the front, back and spine of the binder.
 - 2) Multiple binders shall be provided if required, although single binders are acceptable for each site if possible.
 - 3) If multiple binders are provided, they need to be labeled as Volume 1, 2, etc., with covers which indicate generally what is included in the manual.
 - 4) The manuals shall be labeled on the front cover, the spine, as well as a title page inside the front cover.
- g. Paper, Binder Size & Capacity.
- 1) Paper. Manuals shall be printed on first quality paper, 8-1/2" x 11" size with standard three hole punching.
 - 2) Minimum & Maximum Binder Size. All O&M volumes shall have a maximum binder depth of 4 inches and a minimum binder depth of 1 inch.
 - 3) Capacity. Binders shall not be filled to more than 90% of capacity (*as measured after all final material is submitted and inserted into the O&M Manuals*).
 - 4) Space for Deferred Submittal Items. Contractors are responsible for reserving adequate space in binders for deferred submittal items (*ie. where placeholders as noted above are included*).
 - 5) Overfilled Binders. If binders are overfilled (*either at initial submittal or final submittal*), the Contractor will be fully responsible for providing larger binders (*subject to the maximum size noted above*), or for splitting the O&M submittals into additional binders, and reformatting all the indexes, table of contents and other items as required, all at no additional cost to the Owner.
- h. Volume 1 Requirements. In addition the cover & TOC information noted above, the first equipment O&M binder shall include the following information as a minimum (*separated by index tabs*).
- 1) Supplier Summary.
 - a) Summary sheet listing each supplier's name, address and telephone number along with manufacturer's job number and/or purchase order number for all equipment supplied. This summary shall be included at the front of the binder, behind the TOCs.
 - b) The material or equipment supplier information shall also be included at the front of each individual tab section as applicable (*for the equipment under that tab section*).
 - 2) Certificate of completion & warranty (*in letter form, per Section 01750*) from the Contractor certifying that all materials, equipment and workmanship incorporated into the project are in accordance with the drawings and specifications, and that all work is free of defects and in proper operating condition at the time of project completion. Any exceptions (*if any*) must be listed and the justification for the exceptions given. The certificate of completion letter shall also include a written warranty against defect for the length of the warranty period from the date of substantial completion, covering all workmanship and materials used in the project. The warranty statement may exclude defects or damage caused by abuse,

modification, or improper maintenance or operation by persons other than the Contractor, subcontractors, suppliers, or any other individual or entity for whom the Contractor is responsible; or normal wear and tear under normal usage.

- 3) Permits & Final Inspection Certificates. Include the following.
 - a) Photocopies of building, plumbing, mechanical and /or electrical permits, as well as photocopies of the final inspection certificates for each.
 - b) Photocopies of laboratory and field test reports.
- i. O&M manuals shall include, but not be limited to, the following (*any additional information required by the individual specification sections or submittal review comments shall also be provided*).
 - 1) Equipment List (BOM). Behind the submittal information noted above, each tab section shall include a complete list of equipment and appurtenances provided, complete with manufacturer and model number (*ie. bill of materials*). If there are any differences between the bill of materials included in the submittal information and that provided, provide a corrected bill of materials.
 - 2) Copies of Contractor Construction Submittals, Review Comments, Confirmation.
 - a) Submittal Copies. For material or equipment included in the O&M manual, include a copy of the contractor construction submittal for that item of material or equipment.
 - b) Submittal review comments. For material or equipment included in the O&M manual, include a copy of the submittal review letter or comments from the engineer or owner (*color copies required where submittals or submittal comments included color*).
 - c) Review Comment Confirmation Summary. With each submittal review copy included, provide a written summary specifically indicating the manner in which each comment or correction noted on the shop drawings or construction submittals was addressed (*ie. for those submittals which were approved subject to conditions or listed as "furnish as corrected"*).
 - 3) Manufacturer Warranties.
 - a) Copies of all required or provided manufacturer warranties shall be included at the front of each applicable tab section.
 - b) Provide photocopies of warranty registration cards filled out with the appropriate information, where applicable.
 - 4) Factory Tests & Reports.
 - a) Copies of factory tests & reports as required by the individual specification sections shall be included in the tab section for the applicable equipment.
 - 5) Startup & Commissioning Reports, Field Tests & Reports.
 - a) Copies of startup and commissioning reports and field test reports shall be provided for all equipment which requires commissioning and/or startup by manufacturer's representative.
 - b) Copies of equipment field startup and field test reports shall be included in the tab section for the applicable equipment.

- 6) Written Configuration Summary for Programmable Equipment.
- a) Provide written configuration summary sheet(s) for all programmable equipment, including a listing of all settings which are different from the manufacturer's defaults.
 - b) Summary of configured level, pressure, alarm or other settings, and action by equipment when these settings are reached (*on either rising or falling levels*).
 - c) These summary sheets shall be in addition to digital or electronic copies of configuration settings which are provided for use and reference by the Owner.
- 7) Training Summary. Overview of topics covered during training provided as required by the individual specification sections.
- 8) Service Contracts, etc.
- a) Copies of any service contracts provided shall be included near the front of the each applicable tab section (*behind any applicable configuration summary sheets*).
 - b) Where service is to be provided during the warranty period (*including but not limited to cellular service contracts*), provide a summary sheets listing the applicable equipment, the service contract or account number (*or similar identifying information*), as well as the name, phone number and email address of the person to contact for service requests, or in order to extend or modify service contracts at the end of the initial period.
- 9) Manufacturer Information. Where not included in submittal information referenced above, provide complete manufacturer information for each equipment item, including the following as applicable.
- a) Descriptive literature, bulletins or other data covering the equipment or system shall include, but not be limited to the following (*as applicable*), either in the included submittal data or in the O&M information.
 - (1) General arrangement drawing.
 - (2) Sectional assembly.
 - (3) Dimension print.
 - (4) Materials of construction.
 - (5) Parts list with assembly drawings.
 - (6) Recommended spare parts list with part and catalog number.
 - (7) Utility requirements.
 - (8) Lubrication recommendations and instructions.
 - (9) Drive dimensions and data.
 - (10) Pump seal data.
 - b) Description of equipment controls and associated instrumentation.
 - c) Assembly, installation, alignment, adjustment and checking instructions.
 - d) Operating instructions.
 - e) Maintenance instructions including trouble-shooting guidelines, lubrication and preventive maintenance instructions with task schedule.

- f) Manufacturer's recommended inspection & maintenance schedules. For rotating equipment, this shall include recommended maintenance schedules based on calendar time and run time hours, both for the motors and the rotating equipment.
 - g) List of special tools and equipment required for operation and maintenance.
 - h) Schematic piping diagrams, where applicable.
 - i) Schematic wiring diagrams.
 - j) Programming instructions for any controllers or other programmable equipment. Copies of the any required software, including registration cards, shall be provided in conjunction with the O&M manuals.
 - k) Printout and/or electronic copy of any programming and/or setpoints for controllers or other programmable equipment, including VFDs, as well as a printed summary of settings which are different from manufacture defaults.
- j. Drawings. Drawings shall be reduced to 11" x 17". Where reduction is not possible, larger drawings shall be folded separately and placed in envelopes, which are to be bound into the applicable manual binder.
- k. As-built Information & Equipment Field Modifications.
- 1) Field modifications to equipment during installation shall be included or summarized in the manual so that the manual reflects as-built conditions.
 - 2) Revisions to the manufacturer provided information may be submitted for incorporation into the manual where appropriate.
 - 3) The Owner's Representative reserves the right to return all manuals to the Contractor for revision to reflect as-built conditions.

PART 3: EXECUTION

Nothing additional.

PART 4: SPECIAL PROVISIONS

None.

SECTION 01750 PROJECT CLOSEOUT

PART 1: GENERAL

1.1 SCOPE

- a. This section details the general requirements pertaining to the closeout of the construction project. Not all requirements are listed herein and the Contractor shall provide all paperwork and closeout items required by the contract.

1.2 CLOSEOUT TIMETABLE

- a. The Contractor shall establish dates for equipment testing, acceptance periods, and on-site training sessions (as required under the contract). Such dates shall be established not less than 10 days prior to beginning any of the foregoing items, to allow the Owner, the Owner's Representative, and their authorized representatives sufficient time to schedule attendance at such activities. The timetable shall be presented to the Owner and the Owner's Representative in a written format.

1.3 SUBSTANTIAL COMPLETION

- a. Unless a more restrictive definition is included in the Contract Documents, Substantial Completion is that degree of completion of the project's facilities and operating systems sufficient to provide Owner the full time, uninterrupted, and continuous beneficial use and operation of the Work, and (i) all required functional, performance and acceptance or startup testing has been successfully demonstrated for all components, devices, equipment, and instrumentation and control to the satisfaction of Engineer in accordance with the requirements of the Specifications (including test operation of equipment, electrical and control systems to demonstrate that the total system operates as specified, and that all system components operate correctly and communicate with all other system components as necessary for a complete and operable system); (ii) all final building, plumbing, mechanical and electrical inspections required have been completed and any identified critical defective or incomplete Work replaced or corrected; (iii) occupancy permits and certifications (if any) have been issued by jurisdictions having authority, *which shall include final inspection & acceptance of work by all public agencies with jurisdiction over the road or right-of-way where the work occurred*; (iv) all appurtenant operations and maintenance features, as well as access and safety features (ie. stairs, handrails, ladders & ladder safety devices, motor guards, safety signs & notices, emergency eye-wash/showers, etc.) have been installed and are fully functional; and (v) all required record drawings and/or O&M manuals/information (where applicable) have been submitted and accepted by the Owner. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.
- b. When the Contractor considers that the Work is substantially complete (as defined herein), the Contractor shall prepare for submission to the Owner's Representative a list of items to be completed or corrected, and a detailed schedule for completion of all outstanding items, and request a substantial completion inspection. The failure to include any items on such list or schedule does not alter the responsibility of the Contractor to complete all work in accordance with the Contract Documents and within the specified

contract time.

- c. When the Owner's Representative determines, on the basis of an inspection, that the Work is substantially complete, the Owner's Representative will then prepare a Certificate of Substantial completion which will establish the date of substantial completion; state the responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the work and insurance; and fix the time within which the Contractor shall complete the items listed therein.
- d. Warranties required by the Contract Documents shall commence on the date of substantial completion of the work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion. The Certificate of Substantial Completion shall be submitted to the Owner and the Contractor for their written acceptance of the responsibilities assigned to them in such certificates.
- e. Upon substantial completion of the work and upon application by the Contractor and certification by the Owner's Representative, the Owner shall make payment, reflecting adjustment in retainage, if any, for such work or portion thereof, as provided in the contract documents.

1.4 WRITTEN RELEASES WHEN WORK IMPACTS PRIVATE PROPERTY

- a. Whenever any of the work is on, through or impacts property other than that owned by the Owner (ie. private property), the Contractor shall furnish the Owner with written confirmation (from the subject property owner or proper authority representing the property owner) that the restoration of structures, utilities and/or surfaces has been satisfactorily completed.
- b. Such confirmation shall be submitted prior to final acceptance of the Work by the Owner or final payment.
- c. If, in the opinion of the Owner, the release is arbitrarily withheld, the Owner may at its sole discretion accept the portion of the Work involved and cause final payment therefore to be made.
- d. Failure by the Owner to verify that all such written confirmations have been submitted prior to final payment shall not relieve the Contractor of the responsibility of restoring all structures, utilities and/or surfaces to the satisfaction of the subject property owner, and of correcting any problems which come to light during the warranty period.

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 FINAL SUBMITTALS

- a. The Contractor, prior to requesting final payment, shall obtain and submit the following items to the Owner's Representative for transmittal to the Owner:
 - 1) Written guarantees and/or warranties, as required.

- 2) O&M information and instructions as specified in section 01705.
- 3) Maintenance stock items; spare parts; special tools as specified.
- 4) Completed record drawings.
- 5) Certificates of inspection and acceptance by local governing agencies having jurisdiction.
- 6) Written releases from all parties (including private property owner's whose properties were used for yard or staging areas or were damaged) who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.
- 7) Copies of final inspection certificates for all required building, electrical, mechanical or plumbing permits.
- 8) Equipment manufacturer's startup test reports, installation certifications, and warranties.
- 9) Letter from contractor listing any follow-up training, inspection or service visits required under the contract documents, and acknowledging that these training, inspection or service visits will be provided as required or requested by the Owner. The letter shall also acknowledge any final punchlist items that were deferred to a later time due to weather or other conditions.
- 10) Contractor's written warranty and certification letter as specified in this section.
- 11) Written certification by the Contractor's surveyor that existing survey monuments were not disturbed, or that disturbed monuments were reset and notification filed with the County Surveyor (*including a written list and a sketch or drawing showing the location of all survey monuments verified or reset, as summarized below*).

1.7 CORRECTION OF DEFECTIVE WORK

- a. The Contractor shall comply with the defective Work correction requirements contained in the General Conditions, during the construction period or during the warranty period.
- b. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required corrective work, and any repair or resurfacing constructed by the Contractor which becomes necessary by reason of such settlement shall likewise be considered as a part of such required corrective work unless the Contractor shall have obtained a statement in writing from the affected private property owner or public agency releasing the Owner from further responsibility in connection with such repair or resurfacing, including post construction settlement.
- c. 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.

1.8 FINAL WALKTHROUGH INSPECTION

- a. After all preliminary punchlist items and/or non-compliance or uncompleted work items (identified in substantial completion or other inspections) have been completed, the

Contractor shall submit a written request to the Owner's Representative stating that all work is complete and requesting a final inspection.

- b. The Contractor shall complete and sign off all preliminary punchlist items with the Owner's Representative. The Contractor shall participate in a final walkthrough inspection with the Owner and Owner's Representative, at which time the final punchlist will be prepared.

1.9 WRITTEN WARRANTY & CERTIFICATION FOR FINAL PAYMENT

- a. The Contractor shall provide a written certification and warranty letter, addressed to the Owner, but submitted to the Owner's Representative. The letter shall be on the Contractor's company letterhead, and shall be substantially as follows (*any changes to the wording below must be acceptable to the Owner's Representative*):

Date (__/__/20__)

The City of Aumsville
595 Main Street
Aumsville, Oregon 97325

RE: Aumsville Wastewater Treatment Plant Improvements

To Whom It May Concern:

We the undersigned do hereby certify and warrant that all materials and equipment supplied and installed, and all work performed under the terms of the Contract Documents, was in conformance with the construction drawings & specifications except as otherwise approved in writing by the Owner's Representative. We further certify that the materials supplied for this project conform to the American Iron and Steel (AIS) requirements instituted by Section 746 of Title VII of the Consolidated Appropriations Act of 2017 and subsequent appropriations for WWD Projects.

The general project warranty begins at substantial completion (as determined by the Certificate of Substantial Completion) and is in effect for a period of one (1) year. This general project warranty period does not limit or reduce any manufacturer's warranty which may be longer than the general project warranty (for equipment or systems which were provided and installed under this contract).

Where a separate Certificate of Substantial Completion is issued for different phases of the project, the term of the general project warranty is based on the date of substantial completion granted for each phase. All other work constructed after substantial completion shall be warranted for not less than one (1) year from date of installation, or the end of the general project warranty period, whichever is longer.

All materials & equipment installed were new and in good working condition at the time of substantial completion. All work is free from defects, and conforms to specifications provided in the Contract Documents. If, during the warranty period, any work is found to be defective or not in conformance with the requirements of the Contract Documents, we will promptly remedy, at our expense, any and all defects or deficiencies, and will pay for any damage to other work resulting from occurrence of said defects or the correction of

same, upon written notice from the Owner.

This warranty excludes remedy for damage or defect caused by abuse, modifications not executed by us, improper or insufficient maintenance, improper operations and normal wear & tear under normal usage.

We also certify that:

1. Where required under ORS 279C.800-870, payment to laborers, workers, mechanics or other applicable personnel employed by the Contractor or subcontractor on this Work was not less than the prevailing wage rates specified in the Contract Documents; and
2. All claims and indebtedness for material and labor and other services performed and/or completed in connection with these Specifications have been paid, except for work by subcontractor(s) for which a portion of such payment (or retainage) is withheld by Contractor pending final acceptance of said subcontractor's work and final payment/release of retainage by Owner; and
3. All moneys due the Industrial Accident Fund (ORS 279C.505), the State Unemployment Compensation Trust Fund (ORS Chapter 657), the State Department of Revenue (ORS 279C.505 and ORS 316.162 to 316.212) hospital associations and/or others (ORS 279C.530) have been paid; and
4. All permit final inspections and approvals are complete; and
5. Contractor has contacted all parties affected by the work (including agencies with jurisdiction, as well as public & private property owners whose property was utilized by the Contractor or on whose property work was conducted) and has verified that all restoration work has been completed to the approval of each of the affected parties, wherein each has jurisdiction; and
6. Contractor releases and discharges City of Aumsville of and from all liabilities, claims, obligations and actions arising under the Contract, including any and all claims by third parties because of the performance of the Work; and
7. Contractor and the surety for this Contract shall defend, indemnify and save City of Aumsville harmless from any liability or expense because of any claim on any Bond or any other claim related to the Contract or the Work; and
8. There have been no unauthorized substitutions or assignment of subcontractors; nor have any subcontracts been entered into without the names of the subcontractors having been submitted to the Owner prior to the start of such subcontracted work;

Sincerely,

Contractor name & representative name

cc: Westech Engineering, Inc.

- b. The Contractor's request for final payment shall be accompanied by an executed copy of the "Contractor Application for Payment & Certification" form included in the Information For Bidders section herein.

1.10 WRITTEN "EXISTING SURVEY MONUMENT CERTIFICATION" (prior to final payment)

- a. Prior to requesting final payment, the Contractor shall submit a letter certifying that existing survey monuments of record (*including but not limited to property and street monuments*) were located and marked prior to construction, and that the condition of the existing survey monuments was verified after completion of the work (*ie. not disturbed*), and identify the licensed surveyor who performed this work.
- 1) If no survey monuments were removed, disturbed or destroyed during construction, the letter shall state the date on which the surveyor verified that all existing monuments were checked and none disturbed, and shall include a map, drawing or sketch of the monuments checked, with callouts for each monument; OR
 - 2) If any survey monuments were removed, disturbed or destroyed during construction, the letter shall summarize which monuments were disturbed, and the date(s) on which these survey monuments were replaced by a Registered Professional Surveyor (*retained by the Contractor*) licensed in the State of Oregon in accordance with ORS 209.150, and that required notice was provided to the County Surveyor. Photocopies of the survey documentation and/or maps submitted to the County Surveyor shall be submitted with the certification letter.
- b. This requirement shall apply whether there is a specific bid item for survey monument restoration, or whether it is considered to be incidental work for which no separate payment is made.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

PART 4: SPECIAL PROVISIONS
None.

SECTION 01800
SURVEY WORK DURING CONSTRUCTION, BY CONTRACTOR

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing of all labor, materials, equipment and services necessary for the completion of Construction Survey Work in accordance with the Contract Documents and as required to complete the work.
- b. The requirements of this section will be strictly enforced. Particular attention should be given to the requirements for construction staking. The Contractor shall ensure that physical hubs and lathe or PK nails in pavement (*or other means if approved by the Owner's Representative*) are provided with suitable offsets to avoid conflict with the work being undertaken, installed at the spacing and locations required by the specifications. In all cases, construction staking (*hubs and lathe, PK nails in pavement or equal*) shall be installed at locations and intervals required to allow the Contractor field crews and an inspector to field verify that the locations, elevations and alignments of improvements being installed are along the correct alignment, and at the correct location and elevation. Failure to provide, protect, and maintain the required construction staking may result in issuance of a stop work order until proper construction staking is installed.

1.2 RESPONSIBILITY OF CONTRACTOR TO RETAIN SURVEYOR

- a. The Contractor shall retain and pay for the services of a registered Land Surveyor (*licensed in the State of Oregon*) to locate and mark existing survey monuments of record (*and replace disturbed survey monuments as required*), as well as to establish construction control and perform construction surveys (*ie. construction staking*) as required to establish the locations, lines and grades of curbs, grading, pipelines, structures, appurtenances and other improvements indicated on the drawings or specified.
- b. The Contractor and the Contractor's surveyor shall be responsible for reviewing the drawings and verifying that the grade & invert elevations (*including existing invert elevations*), stations and slopes listed on the drawings correspond (*and match existing or new finish grades as applicable*), as well as conforming with all requirements of this and related sections.
- c. Report Discrepancies Immediately. The Contractor and the Contractor's surveyor shall be responsible for reporting any discrepancies to the Owner's Representative far enough ahead of construction to allow Owner's Representative to review and make necessary adjustments without delaying the work.
- d. The Contractor shall be responsible for layout of the work and transferring elevations from the construction control provided by the Surveyor as required to properly complete the construction of all improvements included in this project.
- e. The Contractor's surveyor shall be responsible for conducting an as-built survey for preparation of the as-built drawings if required under Section 01043.

f. Responsibility of Contractor's Surveyor Regarding Existing Survey Monuments.

- 1) The Contractor's surveyor shall be responsible for determining the location of survey monuments that need to be located and marked for protection or replacement as specified herein. Existing survey monuments which are not at risk of being disturbed by the Contractor's construction activities are not required to be located and marked.
- 2) Any failure by the Contractor's surveyor in fulfilling these responsibilities to locate, tie and/or mark existing survey monuments shall not entitle the Contractor to additional contract time or additional compensation.

1.3 MARKING & PROTECTION/REPLACEMENT OF EXISTING SURVEY MONUMENTS

- a. Prior to construction, the Contractor's Surveyor shall be responsible for researching, locating and marking all existing survey monuments of record (*including but not limited to property and street monuments*) AND permanent elevation benchmarks which may be at risk of being disturbed by the Contractor's construction activities. This shall include those which may be impacted by construction activities (*whether or not such monuments are shown or noted on the construction drawings*).
- b. Contractor shall not disturb permanent survey monuments, lot stakes, or permanent elevation bench marks unless arrangements have been made to have his surveyor replace said survey markers after construction as noted herein. The Contractor's Surveyor shall be responsible for providing the County Surveyor with any required notice and/or maps as required under ORS 209.140-155. Contractor and Contractor's Surveyor shall bear the responsibility of replacing any survey monument disturbed by construction activities (*whether removed with or without the consent or knowledge of the Owner's Representative*).
- c. If any survey monuments of record are removed, disturbed or destroyed during construction of the project, the Contractor shall retain the services of a registered Professional Land Surveyor licensed in the State of Oregon to reference and replace all such monuments in accordance with ORS 209.150. The Contractor shall be responsible paying all costs related to the replacement of disturbed survey monuments of record.
- d. Each monument shall be replaced within a maximum of 90 days of its being removed, disturbed or destroyed as may be required by ORS 209.140-155. The surveyor shall notify the County Surveyor in writing of all such monuments replaced, and provide all documentation required by the County Surveyor, and pay any applicable recording fees. All monument replacement work shall be completed prior to final payment by the Owner. No separate or additional compensation will be provided for monument replacement work.
- e. When a change is made in the finished elevation of the pavement of any roadway in which a permanent survey monument box is located, Contractor shall adjust the monument cover to the new grade at no expense to the Owner.
- f. See submittal paragraphs below regarding post-construction monument verification requirements.

1.4 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the following,
- b. Submittals for Record.
 - 1) During Construction. Copies of construction survey cut sheets shall be provided to the Owner's Representative for reference during construction (*faxed or emailed copies are acceptable*). Receipt and/or review of these survey cut sheets by the Owner's Representative does not relieve the Contractor of his responsibility to review and confirm all elevations, grades, slopes, etc., and to notify the Owner's Representative of any discrepancies or conflicts.
 - 2) Survey Monument Verification Following Construction. Certification letter from a registered surveyor, summarizing the location and marking of existing survey monuments of record (*and replacement of any disturbed monuments*) as required under Section 01750, as well as required map, drawing or sketch of monuments checked.

A copy of survey documentation and/or maps submitted to the County Surveyor (*pertaining to replacement or restoration of survey monuments, if any*) shall be submitted with the certification letter and exhibits.

1.5 RIGHT-OF-WAY, EASEMENT & PROPERTY LINE MARKING

- a. When the Contractor performs construction in a work zone that is within less than 8 feet of a right-of-way or easement boundary (*or within less than 8 feet of a property line for work on private property*), the Surveyor shall place tall stakes or lathe (*properly identified & marked*) on either end of such a work zone, as well as at points of change in width or direction of the right-of-way or easement line (*or property line*), and at points along the line so that at least two stakes can be seen distinctly from any point within the work area limits.
- b. If the work zone is longer than 50 feet, the boundary marker lathe shall be installed at 50 foot maximum intervals, or closer if required to meet the requirements noted above.

PART 2: PRODUCTS

2.1 SURVEY EQUIPMENT

- a. The surveying equipment used for construction staking, layout of the work and transferring elevations from the construction stakes shall be able to operate within the tolerance limits set by the technical specifications. The Contractor and Contractor's Surveyor shall be responsible for verifying that the equipment is in proper working order and adjustment during all phases of the work. The Owner's Representative may at any time during the project require the Contractor's or Contractor's Surveyor's equipment to be checked for accuracy.

2.2 DIGITAL INFORMATION AVAILABLE FOR USE BY CONTRACTOR'S SURVEYOR

- a. If requested by the Contractor's surveyor, the Engineer will make available the following digital survey & design data for use by the Contractor's surveyor.
 - 1) ASCII point file of the topographic survey and control points.
 - 2) XML file of the design to include surfaces, alignments, profiles & pipe networks.
 - 3) pdf plots of the current construction drawings.
 - 4) AutoCAD drawing files of topographic survey information, surfaces, alignments, profiles, pipe networks, etc. *(but not including mechanical or structural CAD files)*.
- b. No further digital data will be provided to the Contractor or Contractor's surveyor.
- c. The use of the electronic (*digital*) information transmitted herewith is intended for reference for this specific project, and is not to be used for other projects. The electronic media and/or electronic files shall remain the property of the Engineer and is subject to its copyright. Under no circumstances shall delivery of the electronic files for use by the Contractor or the Contractor's surveyor be deemed a sale by Engineer, and Engineer makes no warranties, either express or implied, of merchantability and fitness for any particular purpose.
- d. Any electronic files provided are not construction documents. Differences may exist between these electronic files and corresponding hardcopy construction documents. Construction shall be based on the stamped hard-copy design drawings produced by Westech Engineering, Inc. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by Westech Engineering, and the electronic files, the signed or sealed hard-copy construction documents shall govern. Contractor is responsible for determining if any conflicts exist. Use of these electronic files does not relieve Contractor of Contractor's duty to fully comply with the contract documents including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate work with that of other contractors for the project. No revisions shall be made to the design without the express written consent of the Design Engineer whose stamp is on the hard-copy design drawings.
- e. The electronic files are based on computer aided design (CAD) documents compatible with AutoCAD, based on Engineer's specific software configuration & settings. We make no representations regarding the accuracy or completeness of the electronic files received by Contractor or Contractor's surveyor, or compatibility with any computer or software you may use. By such request of and use of electronic files, Contractor and Contractor's Surveyor explicitly acknowledge that he understands that any translation of CAD data from one computer system, operating system or environment to another (*or conversion from one CAD version or Civil 3D/XML data structure to another*) can and often does result in the loss of important data. This loss can include but may not be limited to: portions of text and dimensions; the existence, location or scale of symbols or other elements of graphics; the internal structure of the data including layers and data attributes; the style or weight of lines; or the completeness, accuracy and/or functionality of Civil 3D data.
- f. By such request of and use of electronic files, Contractor and Contractor's Surveyor

further acknowledge that, while all digital CAD data appears to be extremely accurate, this apparent accuracy is an artifact of the techniques used to generate it and is in no way intended to imply actual accuracy. All users of this data take full responsibility for verifying (*against the stamped hard-copy design drawings*) the correctness of all measurements, areas, inventories, etc. digitally extracted from this data. For example, where shown on the drawings, offset dimensions shall take precedence over the digitally scaled location of structures and utilities. Revisions to the design may be made subsequent to the transmission of this data. It is the responsibility of the user to identify and make all required revisions or corrections to this data required by subsequent design revisions by Westech Engineering.

- g. Any use or reuse by Contractor or by others will be at Contractor's sole risk and without liability or legal exposure to Westech Engineering, Inc. Contractor and Contractor's Surveyor agree to make no claim and hereby agree, to the fullest extent permitted by law, to indemnify, defend and hold harmless Westech Engineering, Inc. (*including Westech's officers, directors, employees, agents, or sub consultants*) against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs arising out of or resulting from Contractor's use of these electronic files. In no event shall Westech Engineering, Inc. be liable for any loss of profit or any consequential damages as a result of use or reuse of these electronic files by Contractor or any party to whom Contractor provides these files.

PART 3: EXECUTION

3.1 GENERAL

- a. The Contractor shall be responsible for coordinating and providing sufficient advance notice to allow Contractor's Surveyor adequate opportunity to complete field surveying prior to construction.
- b. The Contractor shall be responsible for layout of the Work shown on the drawings or as altered or modified by the Owner's Representative, and for transferring alignments, locations and elevations from the construction stakes set by the Surveyor. The Contractor shall use competent personnel and suitable equipment for the layout of the work required.
- c. Survey Control, Hub & Lathe or Equal Construction Staking Required. The Contractor's Surveyor shall establish baselines and benchmarks that in his judgment will enable the Contractor to proceed with the work. This will include establishing construction control, layout lines, and performing initial construction surveys to install & construction stakes (*hub & lathe, PK nails in pavement, etc.*) at locations & spacings specified or as required to establish the lines, locations and grades of pipelines and/or roads, structures and appurtenances at, based on offsets as determined by the Contractor to avoid conflict with the work.
- d. Marked Lathe. Marked lathe shall be installed in the field by the Contractor's Surveyor for all construction hubs (*offset hubs or elevation hubs*) set by the Surveyor. Similar information shall be indelibly marked at PK nails which are set in asphalt surfaces.
- e. Cut Sheets. Contractor's Surveyor shall provide survey cut sheets to the Contractor and the Owner's Representative.

- f. Pavement and/or Curbs. Construction stakes for line and grade of pavement and/or curbs shall be set at a maximum of 50-foot intervals for curb grades of 0.5% or steeper and 25 feet intervals for curb grades less than 0.5% and at low and high points of vertical curves to assure conformance to plan line and grade.
- g. Pipelines, Utilities or Associated Improvements. Construction stakes for line and grade of pipelines, utilities or associated improvements shall be set at a maximum of 50-foot intervals (*or closer if required to assure conformance to plan line and grade*), as well as at all horizontal angle points, grade changes, manholes, catch basins, inlets, valves, meters, vaults or other structures.
- h. Buildings, Slabs, Vaults, Etc. Construction stakes for use as horizontal & vertical points shall be set for all buildings, slabs, vaults or other structures, sufficient to allow the contractor to establish stringlines or other means to accurately locate such improvements, as well as allowing the location of conduits, pipes, or other improvements installed prior to form installation to be accurately set.
- i. The Contractor shall preserve and protect the construction stakes or markers set by the Surveyor until their purpose has been served. Any survey construction stakes or markers that are destroyed or disturbed by the Contractor beyond use, and that are essential to the project or prosecution of the work, shall be replaced by the Surveyor at the expense of the Contractor.

3.2 VERIFICATION OF NEW CURB GRADES ALONG EXISTING STREETS, DRIVEWAYS, PARKING AREAS, ETC.

- a. Where new curbs (*or curb & gutter*) are installed along existing streets, driveways, vehicular access routes, parking lots or similar areas, the Contractor's surveyor shall be responsible to verify that the curb/gutter grades match with the existing edge of pavement (*or sawcut edges as applicable*), based on the design cross slopes for the street, driveway, parking lot or vehicular access route as shown on the drawings, and in order to provide the specified curb exposure (*or drainage notch elevation as applicable*) relative to the new surface finish grade.
 - 1) Any discrepancies shall be reported to the Owner's Representative prior to installation of curb forms or final setting of string-line, and the curb grades adjusted as required to conform with direction from the Owner's Representative prior to concrete placement. Any such adjustment required shall be at no additional cost to the Owner.
- b. If the Contractor or his surveyor fails to verify grades as specified herein, curbs which are placed too high or too low shall be removed and replaced at no additional cost to the Owner, and such failure shall not entitle the Contractor to additional contract time.

3.3 VERIFICATION OF INVERT ELEVATIONS FOR EXISTING GRAVITY PIPELINES

- a. Where new gravity pipelines connect to existing manholes, catch basins or other junction structures, the Contractor's surveyor shall be responsible to verify that the existing invert elevations at such structures match the elevations shown on the drawings. Any discrepancies shall be reported to the Owner's Representative prior to installation of the

new pipelines, to allow the grades to be adjusted if required to conform with direction from the Owner's Representative. Any such adjustment required shall be at no additional cost to the Owner.

- b. If the Contractor or his surveyor fails to verify invert elevations as specified herein, pipelines which are placed too high or too low shall be removed and replaced at no additional cost to the Owner, and such failure shall not entitle the Contractor to additional contract time.

PART 4: SPECIAL PROVISIONS

None.

DIVISION 2

UNDERGROUND, PAVEMENT AND SITE WORK

SECTION 02055
SITE DEMOLITION & SALVAGE

PART 1: GENERAL

1.1 SCOPE

- a. This section includes all demolition, removal and/or abandonment of existing above and below grade structures and appurtenances as designated on the drawings or as necessary to clear space for new construction and/or to rehabilitate existing construction.
- b. The work specified under this section includes but is not limited to the following, including removal of materials from the site:
 - 1) Demolition and removal of designated site utilities, structures, retaining walls, foundations, etc.
 - 2) Demolition and removal of pavements, curbs and gutters, drainage structures, signage, sidewalks, landscaping or similar improvements.
 - 3) Filling or removal of underground tanks and piping.
 - 4) Cutting, capping and removal of existing piping, valves and appurtenances, or existing utilities as required.
 - 5) Filling voids in subgrade created as a result of removals or demolition.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the following:
 - 1) When the material and debris resulting from the Contractor's operations are disposed of at locations off the project, the Contractor shall obtain and submit written permission from the Owner of the property upon which the materials and debris is to be placed. Contractor shall provide executed copy of permit to dispose of waste materials from appropriate jurisdictions.
 - 2) An accurate record of actual locations of all existing utilities and subsurface obstructions which are to remain in place shall be submitted to the Owner's Representative prior to final acceptance of the project.
 - 3) A time schedule for all demolition work. The schedule shall show demolition in relation to new construction, including any temporary facilities. The demolition and procedures schedule shall be submitted in accordance with Section 01300.

1.3 COORDINATION AND CONTROL

- a. The Contractor shall:

- 1) Conform to all Federal, State and local laws and regulations for demolition, safety of adjacent facilities, dust control, runoff control, and disposal.
 - 2) Obtain all required permits and licenses and pay all associated fees including disposal charges.
 - 3) Notify affected utility companies before starting work and comply with their requirements.
- b. Contractor shall:
- 1) Not close or obstruct roadways, sidewalks or hydrants without permits.
 - 2) Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.
 - 3) Test soils around buried tanks for contamination.

1.4 JOB CONDITIONS

- a. Structures to be demolished shall be discontinued in use and vacated prior to start of demolition work.
- b. The Owner assumes no responsibility for actual condition of the facilities or structures to be demolished. Prior to the submittal of bid, the Contractor shall visit the site and inspect all facilities to become familiarized with all existing conditions and utilities and to verify the correctness of the drawings.
- c. Conditions existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. Variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.
- d. Items of value to Contractor (which are not designated by the Owner to be salvaged and delivered to the Owner) are to be removed from the site by the Contractor. Storage or sale of removed items will not be permitted on site and shall not interfere with any other work specified in the Contract Documents.

PART 2: PRODUCTS

None

PART 3: EXECUTION

3.1 GENERAL

- a. The contract drawings identify the major equipment and facilities to be removed. Auxiliary utilities such as water, air, drainage, lubrication oil, electrical wiring, controls, and instrumentation are not necessarily shown. These auxiliary utilities, as well as all equipment and pipe supports and all associated wiring, conduits, instrumentation devices pertaining to piping or equipment designated to be removed shall also be removed.

- b. Unless otherwise shown on the drawings or specified, the Contractor shall demolish and remove existing below grade improvements, structures and concrete slabs on grade to a minimum depth of two (2) feet below proposed subgrade, or below existing grade in areas outside of excavation or fill limits.
- c. Unless otherwise shown on the drawings or specified, excavation resulting from demolition and removal operations shall be backfilled with clean earth or crushed gravel and compacted to ninety five percent (95%) of maximum dry density per AASHTO T-180 (Modified Proctor/ ASTM D1557). Burial of debris shall be prohibited unless otherwise shown or directed.
- d. Excavated areas shall be graded to adjacent existing levels and left smooth, clean, free draining and free of debris as approved by the Owner's Representative.
- e. Contractor shall conform to all Federal, State and Local laws when abandoning wells, septic tanks and fuel tanks.
- f. Existing structures and equipment which are damaged in appearance and/or function by performance of demolition work shall be replaced or repaired to Owner's Representative approved condition by the Contractor at no additional cost to the Owner.

3.2 BURNING

- a. The use of burning at the project site for the disposal of refuse, debris, and waste materials will not be permitted.

3.3 PROTECTION OF EXISTING FACILITIES

- a. Contractor shall provide, erect, and maintain temporary barriers and protection as necessary.
- b. Existing landscaping materials, appurtenances and structures that are not to be demolished shall be protected from damage. Damage caused by demolition operations shall be replaced or repaired at no additional cost to Owner.
- c. Contractor shall provide bracing and shoring as required to prevent movement or settlement of adjacent structures, as well as above grade or below grade utilities. Bracing and shoring shall be Contractor's design.
- d. The location of all utilities shall be marked prior to demolition. Contractor shall protect and maintain in safe and operable condition the utilities to remain, and prevent interruption of existing utility service except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities.
- e. Contractor shall clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the work.
- f. During demolition Contractor shall conform to all Federal, State and local laws and regulations for erosion and pollution control.

3.4 SALVAGE

- a. Prior to demolition the Contractor shall carefully remove, for reuse by the Owner, any items so identified by the Owner. Contractor shall notify the Owner in writing two weeks in advance of demolition to allow for field identification by the Owner of salvage items.
- b. All salvaged items shall be removed in their largest pieces that can be easily handled and stored by the Owner's personnel. The Contractor shall deliver these items to the local location designated by the Owner. Contractor shall contact the Owner's Representative to coordinate delivery of salvaged items. All salvaged mechanical and electrical equipment shall be removed in a workmanlike manner and all necessary precautions shall be taken to prevent damage to the existing equipment

3.5 CONDUIT AND WIRING

- a. All disconnected unused wiring shall be removed from the conduits back to their source and any remaining unused conduit shall be capped at a convenient location.

3.6 PAVEMENTS, SIDEWALKS, CURBING AND SIMILAR STRUCTURES

- a. Removal of existing pavements, sidewalks, curbing and similar structures shall end at an existing joint or a sawed joint. Sawed joints shall be straight, neat and free from chipped or damaged edges.
- b. For removal of non-reinforced concrete adjacent to concrete that is to remain, the saw cut shall be the full thickness of the concrete.
- c. For removal of reinforced concrete, the depth of saw cut shall be sufficient to cut all steel unless specified otherwise.
- d. If the concrete is coated with a bituminous surface or other material, the depth of saw cut shall be sufficient to cut into the concrete, not including the coating depth, as specified above.

3.7 EXCAVATION OF RIGID PAVEMENT

- a. The Contractor shall excavate rigid pavement, consisting of concrete or concrete base with a wearing surface of brick or bituminous concrete, wherever such excavation is required for the purposes of this Contract.
- b. Pavement shall be excavated to neat lines and to widths required for trenches for pipe laying and for construction of structures. Adequate provision shall be made to prevent settlement and breakage of pavement beyond the approved limits of excavation. Concrete pavement shall be cut with a concrete saw in conformance with this section.
- c. All pavement broken or damaged beyond the limits above stated, or the approved extension thereof, shall be replaced by the Contractor at his expense.

3.8 MANHOLES, CATCH BASINS, INLETS AND SIMILAR STRUCTURES

- a. Unless otherwise noted on the drawings, existing manholes, catch basins, inlets and similar structures designated to be removed shall be completely removed unless otherwise noted on the drawings.
- b. Unless otherwise noted on the drawings, manholes, catch basins, inlets and similar structures designated to be abandoned shall be removed to an elevation of at least four (4) feet below ground surface or two (2) feet below the finished subgrade, whichever is greater. The remaining void shall be filled with granular backfill material compacted to ninety five percent (95%) of maximum dry density per AASHTO T-180 (Modified Proctor/ ASTM D1557).
- c. All sewer openings in manholes located on sewer lines shall be plugged with 3300-PSI concrete. Length of all concrete plugs shall be a minimum of one and one-half (1-1/2) times the diameter of the pipe.
- d. In-service sewers connected to structures removed or abandoned shall be rebuilt through the area with new pipe. Sewer flow shall be maintained between removal and replacement operations. Abandoned sewers shall be sealed and made watertight with concrete plugs as specified above.
- e. All castings salvaged from abandoned or removed structures shall become the property of the Contractor unless otherwise shown or directed.
- f. The Contractor shall replace, at no cost to the Owner, materials lost or damaged by negligence or by the use of improper methods.

3.9 GUARDRAIL AND FENCE

- a. Existing guardrail and fence shall be carefully dismantled and stored for reuse or for salvage by the Owner unless otherwise shown or directed.
- b. Wood posts and other materials not considered salvageable by the Owner's Representative shall be disposed of by the Contractor.
- c. The Contractor shall replace, at no cost to the Owner, material lost or damaged by negligence or by the use of improper methods.

3.10 SUPERSTRUCTURES, TANKS, CHAMBERS AND SIMILAR STRUCTURES

- a. Care shall be used in demolishing structural elements that are continuous with structural elements remaining in service. Unless otherwise permitted by the Owner's Representative, concrete and masonry shall be cut through entirely with a masonry or concrete saw before removing the unwanted portions.
- b. Methods and equipment used in demolition work shall be chosen so the structural integrity and watertightness of both newly constructed and existing structures remain unimpaired by the performance of the demolition work.

- c. Portions of underground structures that are in the way of new sewers, piping, and structures shall be removed from the area of conflict to a distance not less than twelve (12) inches from any closest point on the new construction.
- d. Extreme care shall be used when removing existing concrete from around reinforcing steel that must be used for securing new concrete. If the reinforcing steel is damaged, the Contractor shall remove additional existing concrete until sufficient existing reinforcing steel is exposed to provide adequate embedment length in the new concrete, as approved by the Owner's Representative.

3.11 EQUIPMENT REMOVAL

- a. All equipment, valves, piping, fittings and miscellaneous steel structures that are removed shall become the property of the Contractor unless otherwise designated by the Owner.

3.12 DISPOSAL OF DEBRIS

- a. Contractor shall not allow debris and/or excess material to accumulate. All debris shall be hauled away from the site as soon as removed.
- b. All debris resulting from demolition operations (i.e. broken concrete, masonry, pipe, miscellaneous metal, trees and brush, etc., as well as mechanical and electrical equipment not designated by the City for salvage) shall be trucked from the work site by the Contractor and disposed of at spoil sites in a legal manner, in full compliance with all Federal, State and local laws and regulations.
- c. The Contractor shall police the hauling of debris to ensure that all spillage from trucks is promptly and completely removed and cleaned up.
- d. During and upon completion of the demolition and salvage operations, the Contractor shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave work areas in a clean condition.
- e. The Contractor shall not sweep, grade, or flush surplus materials, rubbish, or debris into storm drains, channels, lakes, or streams.

3.13 MAINTENANCE OF OWNER'S OPERATIONS

- a. Demolition shall be scheduled and performed in strict conformance with these Specifications and in a manner which results in no interruption of Owner's normal operations beyond that provided for and approved by the Owner. The date and time of commencing the separate items of demolition work shall be submitted to the Owner's Representative for review, and no demolition work shall commence until the Owner's Representative's approval of date and time is given.
- b. All equipment, labor and material costs which are made necessary by the requirements of the Contractor's sequence of operations shall be borne by the Contractor.

3.14 USE OF EXPLOSIVES

- a. The use of explosives for the work of removal of structures and obstructions is PROHIBITED.

PART 4: SPECIAL PROVISIONS

None.

SECTION 02100
CLEARING AND GRUBBING

PART 1: GENERAL

1.1 SCOPE

- a. This section includes grubbing, stripping and otherwise clearing of the construction site in accordance with the drawings and as specified herein or ordered.
- b. This work includes the removing and disposal of all trees, roots, stumps, vegetation and debris as necessary to accommodate new construction or to grade the site and the preservation of all vegetation and other objects designated to remain.

1.2 SUBMITTALS

- a. Spoil Site Permit: When the material and debris resulting from the clearing and grubbing operations are disposed of at locations off the project, the Contractor shall obtain written permission from the Owner of the property upon which the material and debris is to be placed. Contractor shall also obtain any required permits to dispose of waste materials as required by appropriate jurisdictions. Upon request by the Owner, the Contractor shall submit copies of the written permission and permits.

1.3 PROTECTION

- a. The Contractor shall provide the necessary protection to prevent damage, injury or loss of property at the site or adjacent thereto, including wetland areas, trees, shrubs, lawns, walks, pavements, roadways, monuments, structures and utilities not designated for removal, relocation or replacement in the course of construction.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Paint required for cut or scarred surfaces of trees or shrubs designated to remain shall be a suitable product designed for the specific application.

PART 3: EXECUTION

3.1 GENERAL

- a. Information on the drawings showing existing conditions does not constitute a guarantee that other items may not be found or encountered. All such items not shown on the drawings or specified to remain shall be removed as a part of this contract at the expense of the Contractor.
- b. Verify actual field conditions. Inspect related work and adjacent surfaces. Report all conditions which prevent proper execution of this work to the Owner/Owner's Representative.

- c. All materials and work shall conform to the requirements of the Building Code and other agencies of the governing body having jurisdiction over the work.
- d. Contractor shall obtain permits and inspections and pay all fees required for this work.
- e. All companies or authorities owning conduits, wires or pipes running over or under property shall be notified so that arrangements can be made for the removal of any utilities and the capping of any pipes that are to be abandoned. Record location of caps.
- f. Existing trees to remain, as noted on plans or as noted below. Do not disturb or dig into root system.

3.2 CLEARING AND GRUBBING

- a. Only those trees and shrubs shall be removed that are in actual interference with excavation or grading work (or within clearing limits shown on the drawings), and such removal shall be subject to approval by the Owner's Representative. The Owner's Representative reserves the right to order additional trees or shrubs removed at no additional cost to the Owner if, in his opinion, they cannot be maintained or have been damaged by the Contractor's operations.
- b. Clear area within work limits of all surface vegetation, including trees, stumps, down timber, brush, roots, weeds, grasses and deleterious matter.
- c. Clear and remove all internal fences from the site. Perimeter property line fences to remain in place unless otherwise shown or directed.
- d. All trees, stumps, vegetation and debris which are NOT designated to remain shall be cleared and/or grubbed. Stumps and root balls within improved areas or areas with engineered fills shall be removed completely, as well as all significant roots (generally 3/4" or larger in diameter) and other interfering objects, to the satisfaction of the Owner's Representative.
- e. Special grubbing treatment in areas with non-engineered fills to be as follows:
 - 1) Undisturbed stumps, roots and non-biodegradable solid objects which will be at least 3 feet below the final subgrade or embankment surfaces will not require removing, providing they do not extend more than 6 inches above the existing ground surface.
 - 2) In locations to be seeded, stumps, roots and other protruding obstructions shall be removed to a minimum of 6-inches below the final ground surface.
- f. Remove no trees, shrubbery or other vegetation outside of designated clearing limits. Trees and shrubs not designated for removal to be protected from damage during clearing and grubbing operations. Unless otherwise approved by the Owner's Representative, protect roots 2-inches in diameter or larger on trees to remain (such roots shall be neatly cut where removal is required).

- g. Tree branches which extend into the work areas within 8 feet vertically from finish grade shall be clean-cut off next to the trunk and the cuts shall be treated with an approved tree sealant.
- h. The clearing and grubbing shall extend 5 feet beyond the top of the backslope and/or toe of embankment, unless otherwise shown or directed.
- i. At all times, the Contractor shall remain within the property lines and/or easement areas.
- j. Except in areas to be excavated, all holes resulting from the clearing and grubbing operations shall be backfilled and compacted in accordance with applicable sections contained herein.
- k. All timber shall become the property of the Contractor unless otherwise specified.
- l. Protect existing facilities, adjacent properties and survey monuments from damage.
- m. Comply with safety requirements per Federal, State and local codes.
- n. Cleanup adjacent work areas of all litter and debris resulting from the Contractor's operations under this section.

3.3 STRIPPING

- a. Areas of excavation or embankment shall be stripped a minimum of eight-inches of roots, sod, grass, crop residue, decayed vegetable matters and other organic materials, unless otherwise shown or directed.

3.4 DISPOSAL OF DEBRIS

- a. Debris resulting from the clearing and grubbing operations shall be disposed of at spoil sites in a legal manner, in full compliance with applicable codes and ordinances. Stumps, branches, roots, etc. shall not be disposed of within the project limits.

PART 4: SPECIAL PROVISIONS

None.

SECTION 02160
EXCAVATION SUPPORT, PROTECTION, AND COFFER DAMMING

PART 1: GENERAL

1.1 SCOPE

- a. This section specifies requirements for the design, planning, construction, maintenance and removal of temporary excavation support systems for trenches, structures, and open excavations greater than 4 feet in depth as necessary for the protection of personnel and adjacent existing facilities and utilities.

1.2 RELATED SECTIONS

- a. Section 01530 – Settlement and Monitoring
- b. Section 02140 – Control of Water
- c. Section 02201 – Excavation, Fills and Subgrade Preparation
- d. Section 02226 – Trench Excavation and Backfill

1.3 REFERENCES

- a. Oregon Administrative Rules (OAR) 437, Division 3, Subsection P – Excavations.
- b. Oregon Occupational Safety and Health Division (OR-OSHA), Program Directive A-176
- c. Oregon Occupational Safety and Health Division (OR-OSHA), Publication: Excavations–Safe Practices for Small Business Owners and Contractors.

1.4 DESIGN REQUIREMENTS

- a. The Contractor shall retain the services of an engineering firm to design and prepare plans for the excavation support systems and the coffer damming systems for this project.
 - 1) At a minimum two shoring plans are required; one for the excavation for the irrigation/DAF pump station cans, and a second for the trench excavation on the east side of the existing de-chlorination building on lagoon cell 4 dike.
 - 2) Engineered plans for coffer dams shall be provided for all coffer dams. At a minimum, engineered plans are required for the following work.
 - a) The chlorine contact chamber coffer dam system.
 - b) The coffer dams needed to construct the two new cell 1 outlet structures.
 - c) The coffer dams required to install the new cell 4 outlet pipe.
 - d) The coffer dam required for the construction of the new summer discharge pipe and bypass pipe in lagoon cell 2.
 - e) The coffer dams required to complete the modifications of the existing lagoon outlet control structures in lagoon cells 1, 2, and 3 if divers are not used to complete the work.
- b. The design of the excavation support and protection system and all coffer dams shall include a comprehensive engineering analysis by a qualified professional civil or structural engineer and geotechnical engineer licensed in the State of Oregon. The design shall be performed by engineers specializing in this type of work. The retained engineers shall:

- 1) Regularly and presently perform the design of excavation support systems and coffer dams as one of their principal services.
 - 2) Possess technical qualifications, and a minimum of 8 years experience in the design, installation and successful in-service performance of excavation support systems and coffer dams similar to those required for this Project in material, design, and extent.
- c. The Contractor and their retained engineer shall make a determination of the lateral earth and water pressures and any related construction surcharge loads that could result from their construction methods and dewatering activities and shall design the excavation support systems and coffer dams for those pressures and loads at a minimum.
 - d. The excavation support and protection systems and coffer dam systems as provided by the Contractor shall supersede all conceptual representations of such systems as depicted on the Drawings.

1.5 PERFORMANCE REQUIREMENTS

- a. The excavation support and protection systems and the coffer dam systems shall be capable of resisting soil and hydrostatic pressure and superimposed and construction loads and to prevent movement of water and soil units that may cause damage to adjacent structures and utilities, delay the work, or endanger life and health.
- b. Additional excavation support and coffer dam measures shall be designed by the Contractor's retained engineer and subsequently installed by the Contractor should the system as originally designed fail to provide an adequate level of protection to existing structures. Inability to maintain excavations in a suitable dewatered condition and or settlement rates or levels that are rapid, variable, or that define a trend that will approach the maximum settlement limit shall provide the basis for the provision of such additional measures to ensure that the excavations can be sufficiently dewatered and the maximum settlement limit is not exceeded.
- c. The Contractor shall restore all existing facilities damaged, destroyed or altered by soil movements resulting from movements in the excavation support system or nonperformance as well as any damaged caused by a coffer dam failure at no additional expense to the Owner.

1.6 QUALITY ASSURANCE

- a. The Contractor is solely responsible for quality assurance of temporary excavation support systems and coffer dam systems. At a minimum, the Contractor shall continually verify that the support systems are planned, executed and maintained in accordance with the plans prepared by the Contractor's design engineer, applicable codes and regulations and good construction practice.
- b. The Contractor shall conduct the excavation and deploy an excavation safety program in full compliance with the provisions stipulated in Oregon Administrative Rules (OAR) 437, Division 3, Subsection P – Excavations.

- c. The Contractor shall coordinate an on-site inspection of the installed support systems with the Contractor's design engineer to ensure that the system has been installed in conformance to the requirements of the prepared design.
- d. If, for any reason, the Contractor is unable to dewater excavated areas to the limits prescribed, or assumed in the design of the excavation support system, the Contractor shall immediately notify their retained engineer to remedy the situation.

1.7 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents. The review by the Owner's Engineer of all submittal information shall not be construed as a detailed analysis or adequacy of the support system, nor shall any provisions of the review be construed as relieving the Contractor of its sole overall responsibility and liability for the work. The submittals shall include the following:
 - 1) The Contractor shall submit the names of the engaged design engineers and their qualifying technical experience.
 - 2) Shop drawings of an early-work excavation plan prepared and sealed by the Contractor's engineer designating areas of excavation that may proceed in advance of the installation of the excavation support system. The goal of this initial plan is to establish the limits of earthwork that may proceed while the design and approval of the excavation support and protection system is underway. The plan shall be sealed and signed by the professional engineer responsible for its preparation.
 - 3) Shop drawings of the excavation and support protection systems and the coffer dam systems sealed and signed by the qualified professional engineer responsible for their preparation. The shop drawings shall include:
 - a) A description of the proposed excavation support system and/or coffer dam system.
 - b) Arrangement, size and details for the excavation support system and/or coffer dam system.
 - c) Detailed calculations and drawings that represent an explicit representation of the character, extent, and details of the excavation support system and/or coffer dam system.
 - d) A description of the monitoring methods and intervals to be utilized by the Contractor to ensure that the deflection limits of the system do not exceed the limits specified or designed by the Contractor's engineer.
 - e) Construction methods and sequencing to be used for the installation and removal of the excavation support system and/or coffer dam system.
 - f) Anticipated difficulties and proposed resolutions.
 - g) Any related dewatering requirements.
 - 4) The Contractor's engineer shall provide written approval of the excavation support system following the installation and the on-site inspection of the system as described above.

- 5) The Contractor shall submit the name(s) of the designated responsible competent on-site person(s) as described in Safety paragraph of this specification as well as a summary of their qualifying technical experience and formal training.

1.8 PROJECT CONDITIONS

- a. A geotechnical report has been prepared for this Project and is included in the project manual under Appendix A. These reports are not part of the Contract Documents. The geotechnical reports were prepared for the exclusive use of the Owner and their agents to assist with the design of foundation systems for this Project. The opinions expressed in these reports are those of the geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by the geotechnical engineer. The reports shall not be construed as a warranty of accuracy for groundwater levels that may be present across the construction period. The Owner and its agents shall not be responsible for interpretations or conclusions drawn from the data by the Contractor or their agents.
- b. Any additional investigative work deemed necessary by the Contractor for designing the required systems shall be conducted at the Contractor's expense.

PART 2: PRODUCTS

2.1 GENERAL

- a. Provide materials that are either new, or in serviceable condition.
- b. Materials provided shall be suitable for supporting the imposed loads.

PART 3: EXECUTION

3.1 GENERAL

- a. Excavation on the project site shall not commence until the early-work excavation plan as prepared and sealed by the Contractor's engineer has been submitted and reviewed by the Engineer.
- b. The installation and removal of all excavation support systems shall be accomplished in a manner as to prevent damage to existing structures, utilities and site improvements adjacent to the excavation and to maintain the required excavation section and the undisturbed state of soils below and adjacent to the excavation.

3.2 SAFETY

- a. The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The competent person shall meet the requirements established in Oregon OSHA's safety standard for excavations; Division 3, Subdivision P and be capable of performing the stated duties.
- b. During all phases of construction the Contractor shall have, in the excavated work area, a competent person capable of identifying hazards, anomalies, conditions that differ from the excavation support design assumptions, and other factors that would indicate the possibility of hazardous or dangerous conditions in the work area. The responsible person shall possess the authority to ensure employees are removed from hazardous areas and to stop all work when hazardous conditions are identified.

- c. The Contractor shall maintain a close working relationship with the engineer retained to design the excavation support and protection system as long as the system is in use. Any observations made by the competent person as described in the above paragraph shall be reported to the Contractor's engineer to ensure the continued safe performance of the system.
- d. The Contractor is hereby notified that the Owner has not so delegated, and the Owner's Representative does not purport to be a trench, excavation system, or coffer dam safety expert, is not so engaged in that capacity under this Contract and has neither the authority nor the responsibility to enforce construction safety, laws, rules, regulations, or procedures, or to order the stoppage of work for claimed violations of trench, excavation, or coffer dam safety.
- e. The furnishing by the Owner of resident representation and inspection personnel shall not make the Owner responsible for the enforcement of such laws, rules, regulations, or procedures, nor shall such representation make the Owner responsible for construction means, methods, techniques, sequences, procedures, or for the Contractor's failure to properly perform the work necessary for proper excavation safety.

3.3 MONITORING

- a. The Contractor shall monitor the excavation support and protection systems and coffer dams daily during excavation progress and for as long as the excavation remains. Coffers shall be monitored on a daily basis until removed. Promptly report and correct bulges, breakage, excessive water leakage, or other evidence of movement to ensure that the excavation support and protection systems and coffer dams remain stable. The Contractor shall take prompt remedial action should movement in the excavation support or coffer dam system exceed the limits specified or designed by the Contractor's engineer.
- b. The Contractor shall notify their retained engineer immediately if during construction, subsurface conditions are different from those utilized in the design of the excavation support and protection system.
- c. The Contractor shall reference Section 01530 Settlement Monitoring and the details shown on the Drawings for the required monitoring process of the adjacent treatment plant buildings while excavating, shoring, and installing the new final effluent pipeline and the DAF/Irrigation Pump Station. The construction of each of these elements will require excavations located in close proximity to the foundation lines of the existing buildings on the lagoon cell 4 dike.
- d. Excessive settlement of existing structures as determined by the Engineer utilizing data from the Settlement Monitoring Program in conjunction with the settlement limits defined in this specification may provide the basis for the Owner to suspend the Work or any portion thereof until the source of settlement and remedial actions can be determined.

3.4 REMOVAL

- a. The Contractor shall remove the excavation support and protection systems and coffer dams once construction has progressed to the point where permanent construction is able to withstand the lateral soil and hydrostatic pressures.

- b. The Contractor shall remove shoring and bracing in stages to avoid disturbances to adjacent and underlying soils and damage to structures, pavements, facilities and utilities. The Contractor shall repair or replace, as acceptable to the Owner, adjacent work damaged or displaced through the removal of shoring and bracing work.
- c. The excavation support and protection systems shall be removed only if existing facilities and all completed work are protected. The Contractor shall consult with their retained engineer to ensure that removal of the system can be performed without detriment to such facilities.
- d. In the event the excavation support and protection systems cannot be removed without risk to existing facilities, the Contractor shall remove upper portions of the system to a minimum depth of 5-feet below grade other portions as required to avoid conflict with the construction of any part of the Work.
- e. Voids created by the removal of excavation support and protection systems shall be backfilled and compacted with the backfill materials as specified for areas at, or adjacent to, the facilities.

PART 4: SPECIAL PROVISIONS

None.

SECTION 02201
EXCAVATION, FILLS AND SUBGRADE PREPARATION

PART 1: GENERAL

1.1 SCOPE

- a. Work shall include, but not be limited to, the following:
- 1) Stripping of sod and organic matter.
 - 2) Stripping, stockpiling and placing topsoil
 - 3) Rough grading and fine grading.
 - 4) Excavations.
 - 5) Fill construction.
 - 6) Moisture control and compaction.
 - 7) Finishing subgrade and slopes.
 - 8) Disposal of materials.
 - 9) Over-excavation as authorized by the Owner's Representative
 - 10) Protection of existing & new facilities, including shoring & bracing.
 - 11) Coordinating and obtaining all required testing & inspections.
 - 12) Clean up.
 - 13) Excavation dewatering (until backfilling or permanent improvements are complete).
 - 14) Conformance with recommendations of project geotechnical report, or requirements of the design drawings, whichever is more stringent.
- b. It shall be the Contractor's sole responsibility to determine the cost of the work including all quantities during the bidding phase of the project. Any cut and fill quantities listed in any permit shall not be relied upon by the Contractor for estimating the cost of the work. The Owner makes no guarantee of the accuracy of any quantities listed in any permit.

1.2 LABORATORY SERVICES & CERTIFICATION OF ENGINEERED FILLS

- a. Laboratory & Compaction Testing
- 1) Unless otherwise specified or shown on the drawings, the Owner will provide laboratory services by an approved independent laboratory as described below and as noted on the drawings. The Contractor shall be responsible for obtaining & providing all samples requested by the Owner or as required to complete the work.
 - 2) Laboratory Moisture Density Testing. The approved independent laboratory shall complete one moisture density curve per AASHTO T-180 (*ASTM D1557/Modified Proctor*) for each type of subgrade material encountered, and for each type of fill material used on or imported to the site. The maximum dry density and optimum moisture content shall be indicated. The cost of all retests required due to any unauthorized change in fill material shall be borne by the Contractor.
 - 3) Field Compaction Testing & Observation. The approved independent laboratory shall test the subgrade and compacted fill material for conformance with specified "Compaction Requirements," as specified herein or noted on the drawings

(whichever is more stringent), including field observation notes as specified below.

- a) Field test report forms shall include the following information as a minimum (*test reports with insufficient information may be returned to revision, at no additional cost to the Owner*).
 - (1) Project name and portion of project being tested.
 - (2) Date & time of field testing, & method of testing.
 - (3) Specific material being tested (*ie. subgrade, native fill, granular baserock, etc.*).
 - (4) Source of imported material being tested.
 - (5) Location information for each test, adequate to accurately define the location of each test based on information shown on the design drawings.
 - (a) Horizontal location (*ie. stationing or other description*).
 - (b) Vertical location (*ie. depth below design finish grade or other approved method*).
For testing behind retaining walls, each test report shall include the vertical location measured from the subgrade immediately behind the wall (*or the number of block courses up from the bottom for segmental retaining walls*).
 - (6) Wet density, moisture content, and dry density of material being tested.
 - (7) Information referencing the specific proctor test which is being used to compare the field test results against (*ie. AASHTO T-180, etc.*), in addition to listing the maximum dry density value from the referenced proctor test.
- b) Where tests indicate insufficient values, perform additional tests as required by the Owner. Testing shall continue until specified values have been attained by additional compaction effort. The cost of all re-tests shall be borne by the Contractor.
 - (1) Retests shall be referenced to the corresponding failing test.
- c) Identification of subgrade soils as uncompactable by the independent laboratory shall not authorize the Contractor to begin overexcavation without written authorization from the Owner's Representative.

1.3 CONSTRUCTION SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include, but not be limited to, the following:
 - 1) Submittals for Review. Submittals shall include but not limited to the following:
 - a) Certification that material conforms to the requirements contained herein.

- b) Laboratory test results, including sieve analysis & proctor values as applicable.
 - c) Documentation that granular baserock meets the requirements of OSSC (ODOT/APWA) 02630, Base Aggregate where applicable (*note that the sieve analysis for granular backfill or granular baserock must also include screens to determine the percentage passing the #40 sieve and the #200 sieve*).
 - d) Location of each material source for Owner's Representative's approval.
 - e) Geotextile fabric. In addition to data sheets, provide a written statement from the fabric supplier that the proposed geotextile fabric is included on the current Oregon ODOT QPL list for the geotextile application use proposed or specified (*ie. Table 1, 2, 4 or 5 of OSSC (ODOT/APWA) 02320 for drainage fabric, riprap fabric, separation fabric, or embankment/reinforcement fabric as applicable*).
 - f) Sheet piling/shoring/dewatering plan for deep excavations, to demonstrate conformance with the specification requirements and/or recommendations of the geotechnical report as applicable.
- 2) Submittals for Record
- a) Field compaction test results.
- 3) The following documentation shall be required when uncompactable soils are identified by the Owner's Representative.
- a) Photocopy of the applicable portion(s) of the construction drawing plan sheet(s) with the approximate areas of uncompactable soils shown and bubbled. Stationing shall be indicated where available.
 - b) Dimensions of the areas of uncompactable soils, including proposed depth of overexcavation.
 - c) If the uncompactable soils are identified by the independent testing laboratory, the contractor shall submit the date and time of the field visit when the uncompactable soils were identified, along with the name of the laboratory representative.

PART 2: PRODUCTS

2.1 GEOTEXTILE FABRIC

- a. Unless otherwise specified or noted on the drawings, geotextile fabric shall conform OSSC (ODOT/APWA) 02320, Geosynthetics, with minimum property values conforming to 02320 Tables (*see current ODOT QPL list for qualified products*). If submittal information lists typical or average roll values instead of minimum average roll values, the specified table values under OSSC (ODOT/APWA) 02320 shall be increased by 25%.
- b. Widths shall be as required (*to allow for a minimum seam overlap of 18-inches*), or manufacturer's recommendations, whichever is greater.
- c. Reinforcement Fabric. Unless heavier fabric is specified or noted on the drawings, reinforcement fabric (*for over-excavation or under embankments*) shall be a geotextile fabric

included on the ODOT QPL list for OSSC (ODOT/APWA) 02320-5 table (*for woven or non-woven fabric*), generally conforming to the values listed below. Slit film fabrics are not allowed.

- 1) Minimum values for woven: grab tensile strength of 200 lb; tear strength of 80 lb, puncture strength of 430 lbs; AOS of 30.
- 2) Minimum values for non-woven: grab tensile strength of 315 lb; tear strength of 110 lb, puncture strength of 620 lbs; AOS of 30.

- d. Separation Fabric. Unless heavier fabric is specified or noted on the drawings, reinforcement fabric (*for over-excavation or under embankments*) shall be a geotextile fabric included on the ODOT QPL list for OSSC (ODOT/APWA) 02320-4 table (*for woven or non-woven fabric*), generally conforming to the values listed below. Slit film fabrics are not allowed.

- 1) Minimum values for woven: grab tensile strength of 180 lb; tear strength of 68 lb, puncture strength of 371 lbs; AOS of 30.
- 2) Minimum values for non-woven: grab tensile strength of 113 lb; tear strength of 41 lb, puncture strength of 223 lbs; AOS of 30.

2.2 STRIPPINGS

- a. Stripping defined as organic matter such as peat, roots, sod, grass, crop residue, vegetative matter or other materials that cannot be compacted to specified density into a stable mass.
- b. Limits of stripping subject to the Owner's Representative's approval.
- c. Stripping materials to be disposed of off-site unless otherwise noted or directed by the Owner's Representative.

2.3 TOPSOIL

- a. Topsoil is defined as surface soil with organic material, free of subsoil, stones or hard earth 1 inch or larger, free of noxious weeds, roots, sticks or other extraneous material. Topsoil is typically found in depths between 3 and 18 inches below original ground surface, unless otherwise described in the site-specific geotechnical report.

2.4 EXCAVATIONS

- a. Common excavation defined as all material not classified as rock excavation.
- b. Rock Excavation: Rock excavation shall be defined as follows:
 - 1) Rock excavation shall consist only of that solid bedrock or ledge rock (*and boulders over two (2) cubic yards in volume*) which cannot be broken or removed by a D8K (*or approved equal*) with four barrel hydraulics and dual rippers (*ie. during earthwork & grading work*) or a 90,000 pound class Excavator (*PC 400 Komatsu or 450 John Deere or approved equal*) with a single shank ripper mounted separately or on the back of the bucket (*which bucket shall not be more than thirty-six inches [36"] in width*) (*ie. during trench or general excavation work*), but which requires systematic drilling and blasting or the use of rock splitters, pneumatic hammers and wedges.

All D8K's and 90,000 pound class Excavators shall be in excellent operating condition and operated by personnel competent to operate like machinery.

- 2) Removal of existing concrete and asphaltic surfaces does not qualify as rock excavation.
- 3) Boulder volume measurement shall be in accordance with OSSC 00405.81.b.

2.5 ENGINEERED FILLS AND EMBANKMENTS

- a. Select native materials available from excavations and borrow areas after stripping.
- b. All materials shall be free of organic matter, sod, soft or spongy earth, clods, large rocks, or broken pavement fragments, etc., which would preclude compaction at specified density into a stable mass.
- c. All materials shall be within moisture content range necessary to achieve specified compaction.
- d. Fill materials at all times shall be subject to approval of the Owner's Representative.
- e. Materials judged unsuitable to be disposed of off-site as provided herein.
- f. Subject to approval of the Owner's Representative, materials may also include gravel if wet weather prevents use of excavated materials.

2.6 COARSE GRAINED SITE FILL

- a. Coarse grained site fill shall be well graded granular pit run material with no particle greater than 6-inch in diameter and no more than 5% passing the #200 sieve. The Contractor shall provide the Engineer with a sample of the material and the Engineer will inspect the rock source prior to approval. The Contractor shall provide a sieve analysis for approval.
- b. Coarse grained site fill shall conform to the durability requirements of APWA standard specifications for construction sections 02630.11(C) with maximum abrasion of 35% per AASHTO T96 test method, Maximum degradation of 30% per ODOT Test Method 208 and maximum sediment height of 3 inches per ODOT Test Method 208.

2.7 NATIVE EXCAVATED MATERIAL WITH BENTONITE ADMIXTURE (LAGOON DIKE BACKFILL)

- a. Where shown on the drawings, material proposed for use as backfill within lagoon dikes shall be native clay as defined in the Unified Classification System.
- b. Contractor shall strip away and dispose of existing granular material and riprap on the dike surfaces prior to excavating native materials for reuse.
- c. Excavated clay dike material free of vegetable matter, debris, and granular material. Clay material contaminated with debris or granular material shall not be used for backfill within the lagoon dikes.

- d. Excavated clay dike material approved by the Owner's Representative shall be stockpiled for use as backfill. The stockpile location shall be such that the clay is not contaminated with crushed rock or other debris.

Imported Clay. Failure to adequately stockpile native clay material will require the Contractor to provide an alternate clay backfill material acceptable to the Owner's Representative for mixing with bentonite at no additional cost to the Owner.

- e. Bentonite shall be mixed with the stockpiled native clay dike material at a rate of not less than 5 pounds per cubic foot of clay.

2.8 IMPROVED AREAS

- a. Improved areas are site areas that are to be covered with an improved surface, including but not limited to the following:
 - 1) Public or private streets and sidewalks
 - 2) Building crushed rock pads, floor slabs and/or foundations
 - 3) Vehicle parking or driveway areas
 - 4) Truck docks or truck turnarounds
 - 5) Emergency vehicle access drives or turn arounds
 - 6) Pedestrian pavement areas (gravel, AC or PCC)
 - 7) Utility support structures such as generator slabs, utility vaults and pump stations
 - 8) Playground equipment areas with permanent equipment
 - 9) Future improved areas when designated as such on the construction drawings
 - 10) Playground areas with pavement such as baseball courts, tether ball, 4-square etc.

2.9 UNIMPROVED AREAS

- a. Site areas that are outside of the boundary of improved areas as defined herein. Examples of unimproved areas are as follows:
 - 1) Planter areas
 - 2) Landscaping and seeded lawn areas
 - 3) Sportsfield areas
 - 4) Open space areas
 - 5) Playfield areas
 - 6) Bioswales, detention pond or other storm water management areas
 - 7) Any unimproved area that is irrigated or non-irrigated

2.10 GRASS SEED AND MULCH

- a. Grass seed and mulch shall conform to the requirements of OSSC (ODOT/APWA) Section 01030, Seeding, except as modified herein.
- b. Seed mixtures shall be compatible with the immediately surrounding vegetation.
- c. Seed mix to be approved by the Owner's Representative prior to application.
- d. When used, hydromulch shall be applied with grass seed at a rate of 2000 lbs. per acre between April 30 and June 10 or between September 1 and October 1, unless otherwise specified on the drawings or by erosion control permits. On slopes steeper than 10 percent, hydroseed and mulch shall be applied with a bonding agent (tackifier).

Application rate and methodology to be in accordance with seed supplier recommendations.

- e. Mulch shall be either hydromulch or finely chopped fescue or rygrass mulch conforming with OSSC (ODOT/APWA) Section 01030.15
 - 1) **CEREAL GRAIN STRAW (wheat or similar) IS NOT AN ACCEPTABLE SUBSTITUTE without specific written approval.**
- f. When use is allowed by jurisdiction in lieu of hydromulch (in areas other than landscape or lawn areas), dry, loose, weed free fescue or rygrass straw used as mulch shall be applied at a rate of 4000 lbs. per acre (double the hydromulch application requirement). Anchor straw by working in by hand or with equipment (rollers, cleat trackers, etc.). Mulch shall be spread uniformly immediately following seeding.

PART 3: EXECUTION

3.1 CONTRACTOR RESPONSIBILITY TO OBTAIN ALL REQUIRED INSPECTIONS

- a. The Contractor shall be responsible to ensure that all inspections and testing required by the drawings, contract documents or agencies having jurisdiction are completed or witnessed by authorized inspectors prior to proceeding with subsequent work that covers or that is dependent on the work to be inspected. Work completed or covered without obtaining required inspections will be considered as unauthorized work as outlined below, and may be ordered removed at the Contractor's expense.
- b. Failure to obtain necessary inspection(s) and approval(s) shall result in the Contractor being fully responsible for all problems arising from uninspected work.
- c. When excess excavated material is disposed of at locations off the project site, the Contractor shall obtain all necessary permits and pay all fees for disposal of material.

3.2 PROTECTION, CONSTRUCTION ACCESS & STAGING AREAS

- a. The Contractor shall provide the necessary protection to prevent damage, injury or loss of property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, monuments, structures and utilities, including both new and existing not designated for removal, relocation or replacement in the course of construction.
- b. All construction operations, including but not limited to work involved in excavation, hauling, delivering and/or placing earthwork and/or baserock, delivering or storing other construction materials or equipment, shall be performed in a manner to prevent damage to subgrades or other completed or partially completed work.
- c. The Contractor shall be responsible for design, construction and maintenance of any and all structures required for access to the site for construction or delivery/storage of materials, including but not limited to construction access roads and staging areas. The Owner's responsibility to provide access easements or right-of-ways to the construction site shall not be interpreted as relieving the Contractor of his responsibilities under this section.
- d. Unless otherwise shown or specified, the access road and parking lot sections shown are based upon the anticipated loads following construction and not upon the loads during the

construction period. Any increase in road or parking lot size, depth or sections required to accommodate the loads due to the Contractor's choice of construction methods or sequence of operations shall be the responsibility of the Contractor, and shall be supplied at no additional cost to the Owner.

- e. Any advice or recommendations solicited from or given by the Owner's Representative to the Contractor shall not relieve the Contractor of any of his responsibilities under this section.
- f. All site earthwork, including temporary cut slopes, shall be protected from erosion damage caused by groundwater or surface water runoff.
- g. Test Pits: The Contractor shall dig such exploratory test pits as may be necessary in advance of excavation to determine the exact location and elevation of subsurface structures, pipelines and conduits which are likely to be encountered and shall make acceptable provision for their protection, support, and maintenance in operation.
- h. Sheeting, Shoring and Bracing:
 - 1) The Contractor shall furnish and install adequate sheeting, shoring, and bracing to maintain safe working conditions, and to protect newly built work and all adjacent and neighboring structures from damage by settlement.
 - 2) Bracing shall be arranged so as not to place a strain on portions of completed work until the construction has proceeded far enough to provide ample strength. Sheeting and bracing may be withdrawn and removed at the time of backfilling, but the Contractor shall be responsible for all damage to newly built work and adjacent and neighboring structures.
 - 3) All sheeting and/or shoring shall be of the Contractor's design, and shall be in accordance with all Federal, State and Local codes and requirements. While the Owner's Representative may review the shoring plan to verify conformance with the specification requirements and/or recommendations of the geotechnical report, the Contractor shall remain entirely responsible for the means & methods involved with the installation and use of any shoring system, including applicability for use under any particular conditions.
- i. Construction Sheeting Left in Place:
 - 1) The Contractor shall furnish, install, and leave in place, construction sheeting and bracing when specified or when indicated or shown on the drawings.
 - 2) Construction sheeting and bracing, placed by the Contractor to protect adjacent and neighboring structures, may be left in place if desired by the Contractor and approved by the Owner's Representative. All such sheeting and bracing left in place shall be included in the cost for excavation.
- j. Removal of Water:
 - 1) The Contractor shall at all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water

entering the excavations or other parts of the work and shall keep said excavations dry until the permanent facilities to be placed therein (*pipelines, underground structures, pavement, footings, etc.*) are completed (*and backfilled where applicable*). In water bearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation dry as specified.

- 2) The Contractor shall dispose of water from the work in a suitable manner without damage to adjacent property or structures.
- 3) Contractor shall provide silt fences, straw bales, and/or sedimentation basins as required to clarify waters prior to discharge in accordance with Federal, State and Local requirements.

3.3 TOLERANCES AND LINE/GRADE CONTROL

- a. Rough grade per drawing requirements to within 0.30 feet vertically and 1.0 feet horizontally of required lines and grades at any point prior to placing underground utilities unless otherwise specified or shown on the drawings.
- b. Except as otherwise noted on the drawings or specified herein, fine grade per drawing requirements to within 0.10 feet vertically and 0.30 feet horizontally of required lines and grades at any point following installation of underground utilities. Place curb backfill and dress up disturbed areas to same tolerances.
- c. All finished grading surfaces to be smooth, uniform and compact. Unless otherwise shown on the drawings, straight grades shall be run between all finish grade elevations and/or finish grade contours shown on the drawings. Finish grades at transition to existing grades shall match existing grades as required to provide a smooth, free draining surface.
- d. Contractor to provide sufficient survey instruments, blue tops, etc., as necessary to construct subgrades accurately within the above tolerances.

3.4 STRIPPING

- a. Areas of excavation, fills or embankments shall be stripped as required of organic matter such as peat, roots, sod, grass, crop residue, vegetative matter (decayed or otherwise) or other materials that cannot be compacted to specified density into a stable mass.
- b. Stripping limits shall be subject to the Owner's Representative's approval. Contractor shall place no engineered fills until stripping has been approved by the Owner's Representative. Failure to notify the Owner's Representative of unsuitable soil conditions or unsuitable material encountered during stripping or excavation shall result in the Contractor being fully responsible for all problems arising from such unsuitable soils or materials being covered over during filling or grading operations.

3.5 EXCAVATIONS

- a. Excavate to lines and grades required by drawings and/or as staked in field. Sawcut and remove existing AC pavement and PCC as shown on the drawings or as required to complete the work.

- b. Protect existing facilities from damage when excavating, including construction stakes and survey monuments.
- c. Prior to starting excavations, the Contractor shall have appropriate equipment on site to produce a firm, smooth, undisturbed subgrade, true to grade. The bottom of excavations shall be smooth, free of loose materials or tooth grooves prior to placing the granular baserock material. Covering over or filling tooth grooves in the bottom of excavations with granular bedding material is prohibited, particularly where the subgrade consists of fine grained silt or clay material. If the equipment, means or methods provided by the Contractor do not provide excavation bottom conditions as specified, the Contractor shall stop excavation work until appropriate equipment or methods is available. Failure of the Contractor to pothole or otherwise determine soil conditions at the specified excavation depths in sufficient time to obtain appropriate equipment shall not be grounds for additional contract time.
- d. All excavation cut slopes shall be finished smooth, uniform and compact. Excavate for driveways where required by drawings and/or as field determined.
- e. Unauthorized over-excavation shall be backfilled at Contractor's expense in conformance with these specifications using compacted materials approved by the Owner's Representative.
- f. Unless otherwise shown or specified excavation resulting from removal of existing foundations, stumps, boulders, rock or other structures shall be backfilled with clean earth or crushed granular material and compacted to ninety five percent (95%) of maximum dry density per AASHTO T-180 (Modified Proctor/ ASTM D1557). Burial of debris shall be prohibited unless otherwise shown or directed in writing by the Owner's Representative.
- g. Excavated areas shall be graded to adjacent existing levels and left smooth, clean, free draining and free of debris as approved by the Owner's Representative.
- h. Haul suitable excavated materials for direct placement in fill areas as designated on the drawings. Excess and waste materials shall be hauled to off-site disposal arranged for by the Contractor.

3.6 ROCK EXCAVATION

- a. Rock excavation is not anticipated for this project. If rock is encountered the following shall apply.
- b. The use of explosives shall be prohibited. Rock excavation shall be by rock hammer, rock saw or other non-explosive method.
- c. After the Contractor has removed all material that does not meet the above definition of "rock excavation," he shall notify the Owner's Representative in writing and request an inspection to verify the extent of rock excavation required. The profiling of the exposed rock surface shall be done prior to commencement of rock removal activities. It shall be the responsibility of the Contractor to mark the rock in a 25 foot maximum grid pattern and provide a laser, rod and benchmark for use in measuring the rock profiles for determining quantities. The profiling of the exposed rock surface shall be done prior to

commencement of rock removal activities.

- d. Excavations below design subgrade in rock shall be backfilled to subgrade with approved granular material at the Contractor's expense and thoroughly compacted.

3.7 GENERAL SUBGRADE PREPARATION

- a. Except as required for proofrolls, loaded trucks and other heavy construction equipment shall not be operated on subgrades incapable of supporting the loads without deflection.
- b. Except as otherwise allowed herein or by the drawing details or notes, immediately following stripping and excavation work, coordinate with the Owner's Representative to inspect the subgrade. All subgrade shall be inspected by the Geotechnical Engineer prior to rock placement. For bidding purposes, the contractor shall assume that all subgrades shall be proof-rolled with a loaded dump truck. Disturbed areas and areas identified for overexcavation will be identified in the field and these areas shall be repaired as described in the geotechnical report.
- c. Final subgrades shall be finished smooth and uniform to required lines and grades within job tolerances prior to proof rolling or baserock placement.
- d. All design subgrades shall be proof-rolled prior to placement of baserock. Unless otherwise approved by the Owner's Representative, proofrolls shall be conducted with a 10-yard dump truck fully loaded with granular baserock.
- e. Where required, over-excavation of the subgrade shall be accomplished using a large trackhoe with a smooth-edged bucket. Soils that are soft as evidenced by excessive tearing upon excavation by the trackhoe or which evidences excessive pumping under foot pressure may be considered too soft to support and compact the baserock, and additional over-excavation may be required. Excavation work shall not be conducted during nor subgrade left exposed to heavy rains. Typical minimum over-excavation required is 12-inches unless otherwise directed or approved by the Owner's representative.
 - 1) Following over-excavation, geotextile reinforcement fabric as specified shall be placed on the subgrade prior to placement of the well graded granular baserock.
 - 2) No equipment shall be allowed to run directly on the over-excavated subgrade until the full baserock section is in place. Baserock shall be end dumped into the excavated subgrade in a manner to provide at least the full rock section to distribute truckloads and prevent damage to the subgrade. Granular baserock to be spread in lifts using a small dozer to the full rock section indicated prior to operating loaded trucks on the section.
 - 3) Granular baserock as specified shall be graded, and shall be compacted to the specified density at the finish rock grade.
- f. Any soft spots identified by either compaction testing or which exhibit deflection under proof rolling shall be corrected and retested prior to paving or curb placement. By definition, "soft" spots are defined as any area(s) for which the required compaction specification cannot be met, or which deflect, pump or rut under loads.

- g. Should inclement weather (i.e. significant rain) occur between the time the proof roll is performed and either curb placement or paving, another proof roll may be required prior to paving.
- h. No additional payment will be made for subgrade over excavation or repair work that is the result of the contractors excavation techniques. Excavations to final subgrade elevations shall be made using a smooth edge bucket in a manner that does not disturb the native subgrade.

3.8 ENGINEERED FILLS AND EMBANKMENTS

- a. Strip and prepare subgrade as specified prior to placing fill to depths required by drawings, or as the Owner's Representative directs.
- b. Fills and embankment sections shall be constructed to lines and grades shown on the drawings within tolerances specified herein.
- c. Fills to be constructed in lifts, each lift not to exceed 6-inches in compacted thickness unless otherwise specified on the drawings or approved in writing by the Owner's Representative. Each lift to be compacted to specified density prior to placement of succeeding lift.
- d. Fill material from excavations and borrow areas shall be conditioned to proper moisture content before placing and compacting in fills or embankments.
- e. Material shall not be placed in final position in fills or embankments until the moisture content is such that the required compaction can be achieved. Material that is frozen shall not be placed in fills.
- f. Scarify and sprinkle dry lift surfaces where necessary to ensure bond with succeeding lift.
- g. Fills on slopes steeper than 5H:1V shall be keyed and benched into the slope face. Keyways shall be at least 10 feet wide and embedded into competent soil or bedrock. The keying and benching shall meet the approval of the Owner's Representative.
- h. Place topsoil and dress up disturbed areas to the Owner's Representative's satisfaction. Topsoil areas shall be finished smooth, free draining, uniform and free from fragments and debris.

3.9 SOIL/BENTONITE TRENCH BACKFILL MIXTURE PREPARATION

- a. Contractor shall prepare a stripped area for mixing the clay soil/bentonite mixture. The stripped area shall be clean, flat and compacted smooth. Underlying soil shall be compacted smooth, and able to support shall be able to support soil and/or bentonite spreading, processing and loading equipment without deflection.

- 1) White marking paint shall be sprayed on the surface of the soil preparation area prior to spreading of the clay soil to be amended (*to visually delineate the boundary between the mixed soil and the underlying soil*).
 - 2) The clay soil to be mixed with bentonite shall be evenly spread over the preparation area, to a depth not to exceed the depth which the rototilling equipment can thoroughly mix (*8" typical max for walk-behind rear tine tillers*).
- b. Clay backfill for mixing shall have a soil moisture between optimum moisture and 3% over optimum moisture content prior to mixing.
 - c. Apply Bentonite to the native clay at a rate of 5.0 pounds per cubic foot. Pre-measured tarps shall be spread and the actual application rate determined.
 - d. Immediately pulverize area where Bentonite is applied to a minimum depth of eight inches. Rototill or otherwise mix materials until native soil and Bentonite are thoroughly mixed. Adjust moisture of mixed materials to 3% above optimum moisture content per AASHTO T-180.
 - e. Care shall be taken to prevent Bentonite from becoming too wet before proper mixing and compaction. In no event shall the soil liner be allowed to dry out or crack.

3.10 COMPACTION REQUIREMENTS

- a. Compact earthwork to be at least the following densities, relative to the maximum dry density per AASHTO T-180 test method (Modified Proctor/ ASTM D1557).
 - 1) Subgrade None unless to repair disturbed areas
 - 2) Fine grained soils for fill and embankment lifts including lagoon dike backfill ..92%
 - 3) Backfill of over excavation 95%
 - 4) Unimproved areas (planters, landscaping) 82% min, 90% max
- b. Each lift shall be tested and accepted prior to proceeding with the next lift. Materials not placed in accordance with these specifications shall be reconsolidated or removed and replaced, as the Owner's Representative directs and at the expense of the Contractor.
- c. Contractor shall coordinate with the independent laboratory and the Owner's Representative in the performance of in-place density tests.
- d. In addition to moisture-density testing, each compacted layer may be proof rolled to check for deflection or reaction and to verify that no soft or pumping areas remain in any layer or foundation soil.

3.11 CLEAN UP & NATIVE SURFACE RESTORATION

- a. Contractor to clean up site of work of all litter and construction debris caused by him following each of his rough and fine grading operations.
- b. Materials judged unsuitable for placement in any fill area to be removed from site by the Contractor.
- c. Contractor shall replace trees, shrubbery, flowers, and ground cover in kind to match

existing as approved by the Owner's Representative.

- d. **Reseeding & Mulching:** Contractor shall seed and mulch (hydroseed or uniformly by hand) all exposed slopes and disturbed areas which are not scheduled to be landscaped. Grass seed and mulch shall conform to the requirements of OSSC (ODOT/APWA) Section 01030, Seeding, except as modified herein. Mulch used in landscape or lawn areas shall be either hydromulch or well chopped fescue or rygrass mulch conforming with OSSC (ODOT/APWA) Section 010300.15.
- 1) All areas to be seeded & mulched shall be made substantially clear and free of debris, weeds, briars, sticks, loose stones greater than 1-inch, and any other debris detrimental or toxic to the growth of grass.
 - 2) The surface soil in all areas to be seeded shall be in a condition favorable for the germination and growth of grass seed. A minimum of 1/2-inch and maximum of 1-1/2 inches of surface soil shall be in a loose condition.
 - 3) Soil preparation operations shall be directional along the contours of the areas involved.
 - 4) Seed and mulch shall be applied at a time approved by the Owner's Representative when conditions are favorable for germination. Seeding during periods where natural moisture is insufficient to allow germination and growth may require thicker mulch layers and watering to ensure establishment of groundcover.

PART 4: SPECIAL PROVISIONS

None.

SECTION 02226
TRENCH EXCAVATION AND BACKFILL

PART 1: GENERAL

1.1 SCOPE

- a. This section includes all trench excavation, backfill and related work for the construction of the designated pipelines and other incidental work.
- b. Trench Excavation and Backfill Includes:
 - 1) Work of making all necessary trench excavations for the construction of all contract work.
 - 2) Furnishing, placing and use of sheeting, shoring and sheet piling necessary in excavating for and protecting the work and workmen.
 - 3) Performing all pumping and fluming necessary to keep the trenches free from water.
 - 4) Providing for uninterrupted flow of existing ditches, creeks, rivers, treatment plant processes, drains and sewers and the temporary disposal of water from these and other sources during the progress of the work.
 - 5) Damming and cofferdamming where necessary. To be the Contractor's design.
 - 6) Supporting and protecting all structures, pipes, conduits, culverts, posts, poles, wires, fences and buildings, roadway surfaces, curbs, railroad tracks, etc., as well as other public and private property adjacent to the work.
 - 7) Removing and replacing existing sewers, culverts, pipelines and bulkheads where necessary.
 - 8) Removing after completion of the work all sheeting and shoring not necessary to support the sides of excavations.
 - 9) Removing all surplus excavated material.
 - 10) Performing all backfilling, rough grading and compaction to the limits specified or ordered by the Owner's Representative.
 - 11) Restoring all property damaged as a result of the work included under this section.
- c. The Work includes obtaining and transporting suitable fill material from offsite when onsite material is not available.
- d. The Work includes transporting surplus excavated material (not needed for backfill at the location where the excavation is made) to other parts of the work where fill or embankments are required, or to stockpile locations shown on the drawings or directed by the Owner, or disposal of all surplus material to offsite locations provided by the Contractor.

- e. Supplying and installing bentonite sealer material.
- f. Compacting restored dike slopes.

1.2 LABORATORY SERVICES

- a. Unless otherwise specified or shown on the drawings, the Owner will provide laboratory services by an approved independent laboratory as described below and as noted on the drawings. The Contractor shall be responsible for providing all samples requested by the Owner or as required to complete the work. Contractor shall notify Owner's Representative prior to all testing, to allow the Owner's Representative to be present during testing if desired.
 - 1) Sieve Analysis (ASTM C136): One test for each material source and type *(including additional sieve sizes as may be specified)*:
 - a) Selected backfill.
 - b) Granular backfill.
 - 2) Laboratory Moisture Density Testing. The approved independent laboratory shall complete one moisture density curve per AASHTO T-180 (*ASTM D1557/Modified Proctor*) for each size and type of material used for backfill, including the native clay/bentonite mixture. The maximum dry density and optimum moisture content shall be indicated. The cost of all retests required due to any unauthorized change in backfill material shall be borne by the Contractor.
 - 3) Field Compaction Testing. The approved independent laboratory shall perform field compaction testing of the subgrade and compacted fill material for conformance with specified "Compaction Requirements," contained herein:
 - a) Field test report forms shall include the following information as a minimum *(test reports with insufficient information may be returned to revision, at no additional cost to the Owner)*.
 - (1) Project name and portion of project being tested.
 - (2) Date & time of field testing, & method of testing.
 - (3) Specific material being tested *(ie. native backfill, 3/4"-0 granular backfill, etc.)*.
 - (4) Source of imported material being tested.
 - (5) Location information for each test, adequate to accurately define the location of each test based on information shown on the design drawings.
 - (a) Horizontal location *(ie. stationing or other description)*.
 - (b) Vertical location *(ie. depth below design finish grade or other approved method)*.
 - (c) Testing around manholes and similar structures shall reference the specific structure where testing occurs.
 - (6) Wet density, moisture content, and dry density of material being tested.
 - (7) Information referencing the specific proctor test which is being used to compare the field test results against *(ie. AASHTO T-180, etc.)*, in addition to listing the maximum dry density value and optimum moisture from the referenced proctor test.

- b) Where tests indicate insufficient values, perform additional tests as required by the Owner. Testing shall continue until specified values have been attained by additional compaction effort. The cost of all re-tests shall be borne by the Contractor.
 - (1) Retests shall be referenced to the corresponding failing test.
- 4) If CDF or CLSM is required or used on the project, the Contractor shall coordinate and provide CDF or CLSM test cylinders for laboratory testing by an independent testing laboratory as outlined below.
 - a) Test cylinders shall be prepared in conformance with ASTM D-4832. Unless otherwise directed by the Owner's Representative, a set of test cylinders shall be prepared for each day CDF or CLSM is placed on the project. A set shall consist of four (4) cylinders, two for testing at 7 days and two for testing in 28 days.
 - b) Other testing methods more suitable for low strength concrete may be permitted by the Owner's Representative.

1.3 CONSTRUCTION SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include, but not be limited to, the following:
 - 1) Submittals for Review. Submittals shall include but not limited to the following:
 - a) Laboratory test results, including sieve analysis and Proctor values.
 - b) Documentation that granular baserock meets the requirements of OSSC (ODOT/APWA) 02630, Base Aggregate where applicable, as well as additional requirements specified herein (*note that the sieve analysis for granular backfill or granular baserock must also include screens to determine the percentage passing the #40 sieve and the #200 sieve*).
 - c) HMAC mix designs (if applicable).
 - d) Concrete mix design (if applicable).
 - e) CDF or CLSM mix design (if applicable).
 - f) Manufacturer's literature on Bentonite proposed for use.
 - g) Sheet piling/shoring/dewatering plan, to demonstration conformance with the specification requirements and/or recommendations of the geotechnical report.
 - 2) Submittals for Record. In addition to the Owner's Representative, copies of all field test reports shall be provided to all other jurisdictions with authority over right-of-way where trench backfill work is occurring (ie. City, County, ODOT, etc.).
 - a) Field compaction test results (trench backfill).
 - (1) Field test report forms for backfill compaction shall include information referencing the specific proctor test which is being

used to compare the field test results against (ie. AASHTO T-180, date, material, etc.), in addition to listing the maximum dry density value from the referenced proctor test.

- b) CDF or CLSM test cylinder break results.

1.4 DEFINITIONS

a. Classification of Excavated Materials

- 1) Common Excavation (Unclassified) shall be defined, as all material not classified as rock excavation.
- 2) Rock Excavation: Rock Excavation shall be defined as follows:
 - a) Rock excavation shall consist only of that solid bedrock or ledge rock (*and boulders over two (2) cubic yards in volume*) which cannot be broken or removed by a D8K (*or approved equal*) with four barrel hydraulics and dual rippers (*ie. during earthwork & grading work*) or a 90,000 pound class Excavator (*PC 400 Komatsu or 450 John Deere or approved equal*) with a single shank ripper mounted separately or on the back of the bucket (*which bucket shall not be more than thirty-six inches [36"] in width*) (*ie. during trench or general excavation work*), but which requires systematic drilling and blasting or the use of rock splitters, pneumatic hammers and wedges.

All D8K's and 90,000 pound class Excavators shall be in excellent operating condition and operated by personnel competent to operate like machinery.
 - b) Removal of existing concrete and asphaltic surfaces does not qualify as rock excavation.
 - c) The method of boulder volume measurement shall be in accordance with OSSC 00405.81.b.

b. Trench Backfill Zones

- 1) Pipe Bedding - The area from 6-inches under the pipe to springline of the pipe for the width of the trench.
- 2) Pipe Zone - The area from the top of the pipe-bedding zone to 12-inches above the pipe for the width of the trench.
- 3) Backfill Zone - The area from 12-inches above the pipe to bottom line of surface restoration for the width of the trench.

c. Trench Classifications

- 1) Class I Trench - Class I trench shall have granular material in all three zones for backfill material.
 - a) For use under paved roadways, gravel and paved driveways, sidewalks,

- foundation slabs, buildings and other improved areas, or as directed by the Owner's Representative.
- b) Unless otherwise specifically shown or noted otherwise on the drawings, or directed otherwise in writing by the Owner's Representative, use granular backfill for water/sewer/storm service lines and electrical/control conduit runs located within the boundaries of utility facility sites (*including but not limited to pump stations, treatment plants, well sites, etc.*), regardless of surface restoration type.
- 2) Class III Trench - Class III trench shall have granular material in the pipe bedding and pipe zones and native excavated material in the backfill zone for backfill material.
 - a) For use under unimproved areas or as directed by the Owner's Representative (excluding trenches within boundaries of utility facility sites as noted above).
 - 3) Lagoon Dike Trenches – All utility trenches and structure excavations within existing lagoon dikes shall be bedded and backfilled in the pipe and backfill zones with clean native clay soil mixed with bentonite admixture as specified herein.
- d. Improved Areas
- 1) Improved areas are site areas that are to be covered with an improved surface, including but not limited to the following:
 - a) Public or private streets and sidewalks
 - b) Building crushed rock pads, floor slabs and/or foundations
 - c) Vehicle parking or driveway areas
 - d) Truck docks or truck turnarounds
 - e) Emergency vehicle access drives or turn arounds
 - f) Pedestrian pavement areas (gravel, AC or PCC)
 - g) Utility support structures such as generator slabs, utility vaults and pump stations
 - h) Playground equipment areas with permanent equipment
 - i) Future improved areas when designated as such on the construction drawings
 - j) Playground areas with pavement such as baseball courts, tether ball, 4-square etc.
- e. Unimproved Area
- 1) Site areas that are outside of the boundary of improved areas as defined herein. Examples of unimproved areas are as follows:
 - a) Planter areas
 - b) Landscaping and seeded lawn areas
 - c) Sportsfield areas
 - d) Open space areas
 - e) Playfield areas
 - f) Bioswales, detention pond or other storm water management areas
 - g) Any unimproved area that is irrigated or non-irrigated

PART 2: PRODUCTS

2.1 GRANULAR BACKFILL

- a. Unless otherwise shown on the drawings, granular backfill shall consist 3/4"-0 dense graded aggregate meeting the requirements of OSSC (ODOT/APWA) 02630, Base Aggregate, subject to the following additional limitations.
 - 1) Percent passing the #40 sieve shall not exceed 10%
 - 2) Percent passing the #200 sieve shall not exceed 5%.

2.2 CONTROLLED LOW STRENGTH MATERIAL (CLSM) or CONTROL DENSITY BACKFILL (CDF)

- a. Controlled Low Strength Material (CLSM) or Controlled Density Fill (CDF) shall be a mixture of Portland Cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating, self consolidating, free-flowing and excavatable material that will result in a hardened, dense, non-settling fill. Except as otherwise specified herein, material shall conform with OSSC (ODOT/APWA) 00442, Controlled Low Strength Material (CLSM).
- b. CLSM or CDF may be approved as an alternative to "Granular Backfill" for use at locations requested by the Contractor and approved by the Owner's Representative. Where approved by the Owner's Representative, CLSM or CDF may also be used at the option of the Contractor for foundation stabilization material and pavement base material.
- c. Materials used in CLSM or CDF mixture shall conform with the following:
 - Portland Cement: ASTM C-150 or AASHTO M-85 or OSSC 02010.10
 - Fly Ash: ASTM C-618 Class F or Class C or OSSC 02030.10
 - Aggregates: ASTM C-33 or OSSC 02690
 - Water: OSSC 02020
 - Admixtures: OSSC 0240
- d. CLSM or CDF shall attain unconfined compressive 28-day strengths from 50 psi to a maximum of 100 psi. Cylinders shall be taken to demonstrate this. Any material not meeting this requirement shall be subject to removal and replacement at the Contractor's expense.

2.3 NATIVE EXCAVATED MATERIAL

- a. Excavated material free of vegetable matter and debris.
- b. Excavated material approved by the Owner's Representative for use as backfill in designated locations.
- c. Individual particles less than one third (1/3) trench width in greater dimension but no more than 8-inches in diameter.

2.4 FOUNDATION STABILIZATION

- a. Gravel or crushed aggregate or Owner's Representative approved clean, well-graded granular material.

2.5 NATIVE EXCAVATED MATERIAL WITH BENTONITE ADMIXTURE (LAGOON DIKE TRENCHES)

- a. All material proposed for use as backfill within lagoon dikes shall be native clay as defined in the Unified Classification System.
- b. Contractor shall strip away and dispose of existing granular material and riprap on the dike surfaces prior to excavating native materials for reuse.
- c. Excavated clay dike material free of vegetable matter, debris, and granular material. Clay material contaminated with debris or granular material shall not be used for backfill within the lagoon dikes.
- d. Excavated clay dike material approved by the Owner's Representative shall be stockpiled for use as backfill. The stockpile location shall be such that the clay is not contaminated with crushed rock or other debris.

Imported Clay. Failure to adequately stockpile native clay material will require the Contractor to provide an alternate clay backfill material acceptable to the Owner's Representative for mixing with bentonite at no additional cost to the Owner.

- e. Bentonite shall be mixed with the stockpiled native clay dike material at a rate of not less than 5 pounds per cubic foot of clay.

2.6 SOILS BLENDING EQUIPMENT

- a. All equipment shall be adjustable depth rotary tiller, rototiller, or similar equipment capable of tilling and uniformly mixing the bentonite with the native excavated clay material.
- b. Equipment and methods shall be subject to approval by the Owner's Representative.

2.7 BENTONITE

- a. Bentonite product shall be sodium base polymer-treated Wyoming-type bentonite clay. No calcium or altered calcium bentonite products allowed.
- b. Bentonite product shall meet the following specifications:
 - 1) Free swell shall be at least 16.
 - 2) Colloid content of base clay shall be at least 85 percent.
 - 3) Barrel yield shall be 150 ± 10 per American Petroleum Institute standards.
 - 4) Dry fineness of bentonite shall be:
 - Twenty percent (20%) maximum retained on 20-mesh screen.
 - Twenty percent (20%) maximum passing 200 mesh screen.
 - 5) Material shall be free flowing semi-granular material.
- c. Base clay shall have a barrel yield of not less than 75.
- d. Bentonite shall be SG-40 as supplied by American Colloid, Envirogel-10, Plus by Wyo-Ben, Inc., or approval equal.

- e. Bentonite shall have 30-year limited warranty.

2.8 BENTONITE APPLICATION EQUIPMENT

- a. Bentonite shall be spread with bulk lime spreader, seeder, or similar equipment capable of applying the Bentonite in a uniform layer over the stockpiled native or imported clay material.

2.9 GEOTEXTILE CLAY LINER (GCL)

- a. Geotextile bentonite liner shall be a reinforced needlepunched GCL that encapsulates a layer of Volclay sodium bentonite between two nonwoven geotextiles needle-punched together for high internal shear strength and good interface friction performances. The GCL shall be designed for use on steep slope liner/cover systems where overall liner system stability is important.
- b. Geotextile bentonite liner shall be Bentomat SDN as manufactured by Cetco Lining Technologies, or approved equal.

PART 3: EXECUTION

3.1 GENERAL

- a. Where a conflict occurs between or within the specifications and drawings as to the type of trench excavation or backfill required, the more stringent or higher quality requirements shall apply (Owner's Representative shall decide which stipulation will provide the best installation).
- b. Where trees are located adjacent to trench lines and are not scheduled or noted for removal, protect all roots two inches in diameter or larger, unless otherwise approved in writing by the Owner's Representative on a case-by-case basis.

3.2 CONTRACTOR RESPONSIBILITY TO OBTAIN ALL REQUIRED INSPECTIONS

- a. The Contractor shall be responsible to ensure that all inspections and testing required by the drawings, contract documents or agencies having jurisdiction are completed or witnessed by authorized inspectors prior to proceeding with subsequent work that covers or that is dependent on the work to be inspected. Work completed or covered without obtaining required inspections will be considered as unauthorized work as outlined below, and may be ordered removed at the Contractor's expense.
- b. Failure to obtain necessary inspection(s) and approval(s) shall result in the Contractor being fully responsible for all problems and/or corrective measures arising from uninspected work.
- c. When excess excavated material is disposed of at locations off the project site, the Contractor shall obtain all necessary permits and pay all fees for disposal of material.

3.3 NOTICE TO PROPERTY OWNERS

- a. Whenever any of the work is on, through or impacts property other than that owned by the Owner (ie. private property), or will impact access or utility service to any such property, notify all the affected parties one week prior to and again 24-48 hours prior to the impact. Access or utility service shall not be out for more than eight hours in any one day, and not between 6:00 p.m. and 8:00 a.m. unless prior arrangements have been made with the affected property owners.
- b. Contractor shall provide written notice (door hangers or equivalent) a minimum of 24 hours (and a maximum of 48 hours) before beginning operations of which will interfere with access or utility service to existing residences or businesses.
- c. The written notice shall specify the day, date and approximate time (ie. morning or afternoon, etc.) when the work will occur, and shall include the name and cell number for the designated contact person with the Contractor.
- d. In addition to the written notice, a representative of the Contractor shall knock on the front door of all affected residences or businesses on the morning that the work will commence, and attempt to notify the residents or businesses that this work will occur that day. The Contractor shall document in writing the date and approximate time that this attempt was made for the residences or businesses in each area affected.
- e. Written notice shall also be provided to the City Public Works based on the same schedule, and shall include a photocopy of the one of the door hangers used for work in each affected area.
- f. If work on in any affected area is interrupted or stopped for 7 calendar days or more, new notice shall be provided to all affected parties again prior to resuming work.

3.4 PREPARATION

- a. The site of an open cut excavation shall be first cleared of all obstructions preparatory to excavation. It shall be the contractor's responsibility to pothole existing utilities as required or specified to expose potential utility conflicts prior to cutting existing streets.
- b. Wherever trenches are located within paved or hard surfaced areas, a saw wheel, Asphalt Zipper or other approved cutting/grinding devices shall be used prior to excavation. Initial width of pavement cuts shall not be less than the excavated trench width. Final width of pavement cuts shall not be less than 6-inches greater than actual width of the trench just below the pavement (additional sawcutting shall be completed prior to repaving as required to meet T-cut requirements per drawing details or local jurisdiction requirements). All cut or broken pavement shall be removed from site during excavation.
- c. The Contractor shall maintain street traffic at all times and erect and maintain barricades, warning signs, traffic cones, and other safety devices during construction in accordance with Manual of Uniform Traffic Control Devices (MUTCD), Part VI, to protect the traveling public. Provide flagmen as required during active work in roadway areas.
- d. Intent of specifications is that all streets, structures, and utilities be left in condition equal to

or better than original condition. Where damage occurs and cannot be repaired or replaced, Contractor shall purchase and install new material, which is satisfactory to Owner. Plans and/or specifications cover and govern replacement and restoration of foreseeable damage.

- e. The operations shall be confined to the work limits provided. Avoid encroachment on, or damage to, private property or existing utilities unless prior arrangements have been made with copy of said arrangement submitted to Owner's Representative.
- f. Installation of franchise or private utilities (gas, power, phone, cable, data, communication, control, alarms, etc.) or associated conduits in a common trench with water, sanitary sewer or storm sewer is prohibited. Provide a minimum of 3 foot clear separation between water, sanitary sewer or storm sewer facilities and parallel franchise/private utilities or associated conduits.

3.5 TRENCH EXCAVATION

- a. Excavation for trenches in which pipelines and sewers are to be installed shall provide adequate space for workmen to place and joint the pipe properly, but in every case the trench shall be kept to a minimum width. The width of trench at the top of the pipe shall not exceed the limits specified or as shown on the drawings without notification and concurrence in writing by the Owner's Representative. Use of trenches wider than the minimum width will not entitle the Contractor to additional compensation.
- b. Excavation shall be to the depth necessary for placing of granular bedding material under the pipe as shown on the drawings, including proper allowance for pipe thickness.
- c. Over-excavation. If over-digging of the trench occurs (*either inadvertently or due to the need for over-excavation to remove unsuitable material as noted herein*), the trench bottom shall be filled to the design trench subgrade with compacted, well graded, granular backfill/bedding material as specified.
- d. Smooth Trench Bottom Required.
 - 1) Prior to starting trench excavation, the Contractor shall have appropriate equipment on site to produce a firm, smooth, undisturbed subgrade at the trench bottom, true to grade (ie. smooth end bucket or method to provide equivalent result). The bottom of the trench excavation shall be smooth, free of loose materials or tooth grooves for the entire width of the trench prior to placing the granular bedding material.
 - 2) Covering over or filling tooth grooves in the trench bottom with granular bedding material is prohibited, particularly where the trench subgrade consists of fine grained silt or clay material.
 - 3) If the equipment, means or methods provided by the Contractor do not provide trench bottom conditions as specified, the Contractor shall immediately stop trench excavation work until appropriate equipment or methods is available.
 - 4) Failure of the Contractor to pothole or otherwise determine soil conditions at the specified trench depths in sufficient time to obtain appropriate equipment shall not be grounds for additional contract time.
- e. Timing of Trench Backfill & Compaction.
 - 1) Unless otherwise permitted by the Owner's Representative, trenching operations shall not be performed beyond the distance that will be backfilled and compacted

- the same day.
- 2) In general, backfilling shall begin as soon as the conduit is in approved condition to receive it and shall be carried to completion as rapidly as feasible.
 - 3) New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe and proper condition.
- f. Existing Pipe along Same Alignment. Where trenching for piping is in the same alignment as existing piping, the trench depth and pipe embedment shall extend to a minimum of 6-inches below the new piping or 6-inches below the existing piping, whichever is deeper.
- g. Existing Pipes to be Abandoned. Where the excavation activities require the removal of portions of an abandoned pipeline, 3,300-psi concrete plugs shall be installed in the open ends of the pipe. Concrete plugs to be a minimum one and one-half (1½) times the diameter of the pipe. If hand mixed sack-crete type concrete is proposed, it shall be a 4000 psi minimum mix (*approved by the Owner's Representative*), mixed with the minimum amount of water necessary for workability (*5" slump or stiffer*). In no case will dry sack-crete (*either in bags or as loose mix*) be considered as an acceptable substitute for an approved mixed concrete.
- h. Removal of Water:
- 1) The Contractor shall at all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water entering the trench excavations or other parts of the work and shall keep said excavations dry until the pipelines to be placed therein are completed.
 - 2) In water bearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation dry as specified.
 - 3) Additional excavation and/or installation of foundation stabilization materials which may be required due to the Contractor's failure to adequately control water in the trench shall be the Contractor's sole responsibility, so as to provide a stable subgrade as required to install the pipes at the grades and within the tolerances specified.
 - 4) The Contractor shall dispose of water from the work in a suitable manner without damage to adjacent property or structures.
 - 5) Contractor shall provide silt fences, straw bales, and/or sedimentation basins as required to clarify waters prior to discharge in accordance with Federal, State and Local requirements.

3.6 EXCAVATION OF UNSUITABLE MATERIALS (Trench Over-Excavation)

- a. Where soft trench subgrade is encountered in which satisfactory trench bottom stability cannot be obtained by moisture control and/or compaction, the Contractor shall notify the Owner's Representative and the unstable material shall be excavated to the depth required or approved by the Owner's Representative.

- b. Unsuitable materials existing below the Contract bottom limits for trench excavation shall be removed as directed by the Owner's Representative, as required to provide a stable subgrade at the design trench bottom grades. Unless otherwise authorized by the Owner's Representative, such excavation shall be conducted at a time when the Owner's Representative is present and shall not exceed the vertical and lateral limits as approved by the Owner's Representative. These provisions shall apply whether such over-excavation consists of multiple isolated segments or the entire trenchline.
- c. Over-excavation backfill shall be well graded granular foundation stabilization material, compacted in lifts to provide a stable foundation at the design trench grades.
- d. Where the use of open graded angular stabilization rock is specifically approved by the Owner's Representative on a case-by-case basis, the open graded rock shall have geotextile fabric installed under, around and over the open graded rock (*in order to prevent the migration of fines into the void spaces of such open graded stabilization rock, with resultant loss of support and/or settlement over time*).
- e. In all cases, the top of any foundation stabilization material shall be installed so as to allow for the installation of the full required depth of granular pipe bedding material as specified or as shown on the drawings.

3.7 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL

- a. All excavated materials which are unsuitable for use in backfilling trenches or around structures, and materials excavated that are in excess of that required for backfilling and for constructing fills and embankments as shown on the drawings, shall be disposed of by the Contractor at own expense and at disposal sites provided by him as may be required.
- b. Surplus excavated material shall be disposed of at designated spoil sites in a legal manner, in full compliance with applicable codes and ordinances.

3.8 PROTECTION

- a. Test Pits: The Contractor shall dig such exploratory test pits as may be necessary in advance of excavation to determine the exact location and elevation of subsurface structures, pipelines and conduits which are likely to be encountered and shall make acceptable provision for their protection, support, and maintenance in operation.
- b. Sheeting, Shoring and Bracing:
 - 1) The Contractor shall furnish and install adequate sheeting, shoring, and bracing to maintain safe working conditions, and to protect newly built work and all adjacent and neighboring structures from damage by settlement.
 - 2) Bracing shall be arranged so as not to place a strain on portions of completed work until the construction has proceeded far enough to provide ample strength. Sheeting and bracing may be withdrawn and removed at the time of backfilling, but the Contractor shall be responsible for all damage to newly built work and adjacent and neighboring structures.

- 3) All sheeting, shoring and bracing shall be of Contractor's design and shall be in accordance with all Federal, State and Local codes and requirements.

c. Construction Sheeting Left in Place:

- 1) The Contractor shall furnish, install, and leave in place, construction sheeting and bracing when specified or when indicated or shown on the drawings.
- 2) Construction sheeting and bracing, placed by the Contractor to protect adjacent and neighboring structures, may be left in place if desired by the Contractor and approved by the Owner's Representative. All such sheeting and bracing left in place shall be included in the cost for excavation.

3.9 ROCK EXCAVATION

- a. The use of explosives shall be prohibited. Rock excavation shall be by rock hammer, rock saw or other non-explosive method.
- b. After the Contractor has removed all material that does not meet the above definition of "rock excavation," he shall notify the Owner's Representative in writing and request an inspection to verify the extent of rock excavation required. The profiling of the exposed rock surface shall be done prior to commencement of rock removal activities. It shall be the responsibility of the Contractor to mark the rock at 25 foot maximum intervals and provide a laser, rod and benchmark for use in measuring the rock profiles for determining quantities.
- c. Contractor to excavate and remove the overburden exposing the rock surface, allowing the Owner's Representative to profile the excavated trench for rock measurement. The profiling of the exposed rock surface shall be done prior to commencement of rock removal activities.
- d. Where the bottom of the trench encounters ledge rock and/or boulders and large stones which meet the definition of "rock", as described herein, said rock shall be removed to provide 6-inches of clearance to each side and below all pipe and accessories.
- e. Excavations below subgrade in rock shall be backfilled to subgrade with approved granular material at the Contractor's expense and thoroughly compacted.

3.10 REMOVAL OF PCC CURBS & SIDEWALKS

- a. Where trench excavation requires removal of PCC curbs and/or sidewalks, the curbs and/or sidewalks shall be sawcut as required and removed at a tooled joint unless otherwise authorized by the Owner's Representative.
- b. The intention of this requirement is to facilitate the replacement of curbs and sidewalks to the joint pattern of the existing and surrounding curbs and/or sidewalks. The sawcut lines for PCC sidewalk and curb cuts shown on the drawings are schematic and not intended to show the exact alignment of such cuts.

3.11 BACKFILL AND COMPACTION

- a. Backfill Immediately: All trenches and excavations shall be backfilled immediately after

pipe is laid therein, unless otherwise directed by the Owner's Representative. Under no circumstances shall water be permitted to rise in unbackfilled trenches after pipe has been placed.

- 1) Backfilling With Excavated Material: Where specified or directed, material excavated in connection with the work shall be used for backfilling, in accordance with the type of trench classification shown on the contract drawings. No material shall be used for backfilling that contains stones, rock or pieces of masonry greater than 8-inches, frozen earth, debris, and earth with an exceptionally high void content, organic material, or marl. Large pieces of rock or masonry shall not be deposited closer than 12-inches from the completed outside surface of any structure or pipe.
- 2) In no case shall backfill material deposited by machinery be allowed to fall directly on the pipe and in all cases the bucket shall be lowered so that the shock of the falling backfill material will not cause damage.

b. Bedding & Backfill Moisture Control:

- 1) All bedding & pipe zone backfill materials shall be conditioned, aerated or wet as required so that moisture content of each layer is within minus 4 percent to plus 2 percent of optimum moisture content.
- 2) All trench backfill material shall be moisture conditioned as required to allow compaction in layers to specified densities throughout vertical depth of the trench.

c. Pipe Bedding & Pipe Embedment

- 1) Pipe bedding material shall be placed in the trench, smoothly spread, and compacted as required to provide a firm, unyielding support along the entire pipe length.
- 2) Pipe shall be laid directly on the bedding materials. Holes shall be provided for all joints or fittings as required to permit proper assembly.
- 3) Backfill shall be placed in uniform layers on both sides of the pipe to springline. Each layer shall be placed, then carefully and uniformly hand sliced and/or hand tamped under the haunches of the pipe to eliminate the possibility of voids or lateral displacement of the pipe. Care shall be taken to ensure that the material under the haunches of the pipe is sufficiently compacted and consolidated to ensure intimate contact between the backfill material and the pipe or structure (*no voids*).

d. Pipe Zone

- 1) Pipe zone material shall be carefully placed around the pipe and thoroughly hand compacted in uniform layers/lifts and in a manner to provide complete support of the pipe, and to equalize pressure and minimize stress, and to prevent displacement, deflection or damage to the pipe or structures.
- 2) The Contractor shall ensure that backfill around the pipe is adequately placed and compacted so as to prevent the pipe from moving either horizontally or vertically

during the placement and hand compaction of the pipe zone material.

e. Backfill Zone

- 1) After the backfill has been placed and hand compacted/consolidated around the pipe(s) and/or structures to a height of 12-inches over the top as specified above, in a manner to fully and completely support said pipes, structures and conduits, the remainder of the trench shall be backfilled and compacted by mechanical means or machine.
- 2) Allowable Lift Thickness between Compaction Testing. The backfill material shall be deposited in horizontal layers (lifts) not exceeding 30-inches thick, and each layer (*lift*) shall be thoroughly compacted to the specified density by approved methods before the succeeding layer is placed (*including completion of compaction testing*).

If the Contractor fails to perform compaction testing as lifts are placed, the Contractor shall be responsible to excavate down to the required depth with a smooth bucket (*including placement of any required shoring*) and perform the required compaction testing, at the Contractor's sole expense.

f. Backfilling Under Existing Conduits

- 1) Where it is necessary to undercut or replace existing utility conduits and/or service lines, the excavation beneath such lines shall be backfilled the entire length with granular bedding material tamped in place in 6-inch layers to the required density. The granular bedding shall extend outward from the spring line of the conduit a distance of 2 feet on either side and thence downward at its natural slope.

g. Backfilling Under Pavement, Walks & Improved Areas

- 1) Where any pavement, driveway, parking lot, curb and gutter, walk *or improved area* is to be placed over a backfill area, granular material shall be used. The material shall be placed and compacted to the required density in accordance with the specification contained herein.

3.12 COMPACTION REQUIREMENTS

- a. In Class I and III trench classification and in Lagoon Dike Trenches, compaction in the pipe zone (*ie. under and around the pipe*) shall be achieved by hand compaction in horizontal lifts or other approved method to ninety percent (90%) of the maximum dry density per AASHTO T-180 test method.
 - 1) Compaction testing in the pipe zone (*along the sides of the pipe*) may be required by the Owner (*at the Owner's sole discretion*), if the Owner's Representative has concerns about the pipe zone material being adequately hand compacted to fully support the pipe or structure.
- b. In Class I trench classification and in Lagoon Dike Trenches, compaction in the backfill zone shall be achieved by mechanical compaction in horizontal lifts or other approved method to ninety-two percent (92%) of the maximum dry density per AASHTO T-180 test method.

- c. In Class III trench classification, compaction in the backfill zone shall be achieved by ramming, vibration or a combination thereof to at least eighty-five percent (85%) of the maximum dry density per AASHTO T-180 test method.
- d. Typical Maximum Compaction Lift Height.
 - 1) Unless otherwise specified or noted on the drawings, maximum lift height for trench compaction and compaction testing (*above the pipe zone as defined above and on the standard details*) shall not typically exceed 30 inches (*based on this, the maximum backfill height above the crown of the pipe shall not exceed 3½ feet without being compacted*).
 - 2) Where other requirements are specified or noted on the drawings, the more stringent shall apply.

3.13 COMPACTION TESTS

- a. Before mandrel testing and/or TV inspection of sewers or storm lines, all trench compaction shall be completed and compaction tests submitted.
- b. Trenches shall be backfilled and compacted in layers/lifts as specified, to the existing ground surface. Compaction tests, when performed, shall be performed on each layer/lift after compaction.
- c. The initial test series for each type of backfill material shall be continued until the compaction methodology employed has proven to attain the required compaction. Any change in the proven method of consolidation will not be permitted unless approved by the Owner.
 - 1) Initial & subsequent tests shall be in locations and at depths acceptable to the Owner's Representative.
- d. Unless specified on the drawing notes, subsequent tests or series of tests shall be in locations and at depths ordered by the Owner's Representative. The Contractor shall be responsible to perform adequate testing to ensure that settlement does not occur. Any settlement shall be repaired at the Contractor's expense.
- e. The cost of all retests shall be borne by the Contractor.

3.14 SURFACE RESTORATION AND CLEAN UP

- a. Surface restoration shall conform to these Contract Documents where applicable. Restore ground surfaces to original conditions and elevations unless otherwise specified or directed.
- b. Maintenance of such surfaces shall be for a minimum of 12 months following acceptance of work, or the length of the warranty period, whichever is longer.
- c. Clean up and remove all excess materials, construction materials, debris from construction, etc. Replace or repair any fences, mailboxes, signs, landscaping, or other facilities removed or damaged during construction. Replace all lawns, topsoil, shrubbery, flowers, etc., damaged or removed during construction. Contractor to be responsible for seeing that

lawns, shrubs, etc. remains alive. Leave premises in condition equal to or better than original condition before construction.

3.15 SOIL/BENTONITE TRENCH BACKFILL MIXTURE PREPARATION

- a. Contractor shall prepare a stripped area for mixing the clay soil/bentonite mixture. The stripped area shall be clean, flat and compacted smooth. Underlying soil shall be compacted smooth, and able to support shall be able to support soil and/or bentonite spreading, processing and loading equipment without deflection.
 - 1) White marking paint shall be sprayed on the surface of the soil preparation area prior to spreading of the clay soil to be amended (*to visually delineate the boundary between the mixed soil and the underlying soil*).
 - 2) The clay soil to be mixed with bentonite shall be evenly spread over the preparation area, to a depth not to exceed the depth which the rototilling equipment can thoroughly mix (*8" typical max for walk-behind rear tine tillers*).
- b. Clay backfill for mixing shall have a soil moisture between optimum moisture and 3% over optimum moisture content prior to mixing.
- c. Apply Bentonite to the native clay at a rate of 5.0 pounds per cubic foot. Pre-measured tarps shall be spread and the actual application rate determined.
- d. Immediately pulverize area where Bentonite is applied to a minimum depth of eight inches. Rototill or otherwise mix materials until native soil and Bentonite are thoroughly mixed. Adjust moisture of mixed materials to 3% above optimum moisture content per AASHTO T-180.
- e. Care shall be taken to prevent Bentonite from becoming too wet before proper mixing and compaction. In no event shall the soil liner be allowed to dry out or crack.

PART 4: SPECIAL PROVISIONS

None.

SECTION 02231
AGGREGATE BASE ROCK

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing all material, equipment; labor and supervision required installing aggregate base rock as specified or as shown on the drawings, including streets, driveways, parking areas, building pads granular backfill (except trenches) around structures, etc. The terms “baserock”, “granular base”, “granular baserock” or “granular backfill” as used herein, on the drawings or in the Contract Documents refer to aggregate base rock.
- b. All preparatory work and incidental work required to properly complete the work shall also be included under this section.

1.2 LABORATORY SERVICES

- a. Unless otherwise specified or shown on the drawings, the Owner may provide laboratory services by an approved independent laboratory as described below and as noted on the drawings. The Contractor shall be responsible for providing all samples requested by the Owner or as required to complete the work. Contractor shall notify Owner’s Representative prior to all testing, to allow the Owner’s Representative to be present during testing if desired.
- b. Laboratory tests shall be performed to demonstrate that granular baserock meets the requirements of OSSC (ODOT/APWA) 02630, Base Aggregate where applicable (including sieve or screen analysis of fine and coarse aggregate), as well as additional requirements specified herein.
- c. The sample shall meet limits established in OSSC (ODOT/APWA) 02630, Base Aggregate, as well as additional requirements specified herein. If the sample fails to meet set limits, a new source shall be found. The Owner’s Representative shall approve each source of material(s).
- d. Compaction Testing:
 - 1) Laboratory Moisture Density Testing. One moisture density curve per AASHTO T-180 (*ASTM D1557/Modified Proctor*) for each size and type of material used. The maximum dry density and optimum moisture content shall be indicated. The cost of all retests required due to any unauthorized change in backfill material shall be borne by the Contractor.
 - 2) Field Compaction Testing & Observation. The approved independent laboratory shall test the subgrade and compacted fill material for conformance with specified “Compaction Requirements,” as specified herein or noted on the drawings (*whichever is more stringent*), including field observation notes as specified below.
 - a) Field test report forms shall include the following information as a minimum (*test reports with insufficient information may be returned to*

revision, at no additional cost to the Owner).

- (1) Project name and portion of project being tested.
 - (2) Date & time of field testing, & method of testing.
 - (3) Specific material being tested (*ie. granular baserock*).
 - (4) Source of imported material being tested.
 - (5) Location information for each test, adequate to accurately define the location of each test based on information shown on the design drawings.
 - (a) Horizontal location (*ie. stationing or other description*).
 - (b) Vertical location (*ie. depth below design finish grade or other approved method*).
 - (6) Wet density, moisture content, and dry density of material being tested.
 - (7) Information referencing the specific proctor test which is being used to compare the field test results against (*ie. AASHTO T-180, etc.*), in addition to listing the maximum dry density value from the referenced proctor test.
- b) Where tests indicate insufficient values, perform additional tests as required by the Owner. Testing shall continue until specified values have been attained by additional compaction effort. The cost of all re-tests shall be borne by the Contractor.
- (1) Retests shall be referenced to the corresponding failing test.

1.3 CONSTRUCTION SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include, but not be limited to, the following:
 - 1) Submittals for Review. Submittals shall include but not limited to the following:
 - a) Laboratory test results, including sieve analysis and Proctor values.
 - b) Documentation that granular baserock meets the requirements of OSSC (ODOT/APWA) 02630, Base Aggregate where applicable, as well as additional requirements specified herein (*note that the sieve analysis for granular backfill or granular baserock must also include screens to determine the percentage passing the #40 sieve and the #200 sieve*).
 - c) Documentation that granular baserock meets the requirements for other laboratory tests as specified herein.
 - d) CDF mix design (if specified or required).
 - 2) Submittals for Record. In addition to the Owner's Representative, copies of all field test reports shall be provided to all other jurisdictions with authority over right-of-way where trench backfill work is occurring (*ie. City, County, ODOT, etc.*).
 - a) Field compaction test results.
 - b) Weight tickets for all material delivered (where payment is by weight).

PART 2: PRODUCTS

2.1 BASE AND LEVELING ROCK

- a. Base rock and leveling rock shall be dense graded aggregate in conformance with the requirements of OSSC (ODOT/APWA) Section 2630, Base Aggregate, subject to the following additional limitations.
 - 1) Percent passing the #40 sieve shall not exceed 10%
 - 2) Percent passing the #200 sieve shall not exceed 5%.
- b. Gradation shall be as indicated on the drawings. Where not specified on the drawings, gradation shall be as follows:
 - 1) Base Rock: 3/4"-0
 - 2) Alternate single size 1"-0 aggregate as approved by the Owner's Representative.

PART 3: EXECUTION

3.1 GENERAL

- a. The subgrade shall be checked for grade and compaction and accepted by the Owner's Representative prior to placement of aggregate baserock.
- b. Aggregate baserock shall be placed over approved subgrade in accordance with OSSC (ODOT/APWA) Section 00641, Aggregate Subbase, Base and Shoulders, except that plant mixing of aggregate and water shall not be required.
- c. Existing graveled driveways shall be re-rocked and restored to match existing surface(s) where disturbed by construction. Finish with 3/4-inch minus aggregate baserock a minimum of 6-inches deep.
- d. Existing aggregate baserock, when specified on the plans to remain in place, shall be scarified to a minimum depth of 6-inches, moisture conditioned, graded and compacted as specified herein prior to placement of additional aggregate baserock or HMAC pavement.

3.2 COMPACTION

- a. The maximum compacted thickness of each lift of aggregate baserock shall be 6-inches.
- b. The Owner may have tests performed to determine the maximum dry density and optimum moisture content of the aggregate baserock.
- c. All aggregate baserock shall be compacted to 95 percent (95%) of the maximum dry density per AASHTO T-180 (Modified Proctor/ ASTM D1557).
- d. All structures shall be protected from damage when placing and compacting aggregate baserock and backfill.
- e. Contractor shall sprinkle the aggregate baserock with water as necessary to achieve the

required compaction.

3.3 TOLERANCES

- a. Aggregate base courses shall be finished accurately to lines and grades shown on the drawings and within the tolerances specified.
- b. The maximum tolerance on finished rock grade is ½-inch on a 16-foot straightedge with no birdbaths.
- c. All rims shall be adjusted to final grade after leveling rock course is placed and compacted.

3.4 ACCEPTANCE

- a. Final acceptance of the material will be from samples taken on the finished grade in the compacted state.

PART 4: SPECIAL PROVISIONS

None.

SECTION 02260 GEOTEXTILE FABRIC

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing and installing of geotextile fabric and incidentals on the project.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of the Contract Documents and shall include:
 - a) Manufacturer data sheets for each type of geotextile proposed for use, including values for test parameters specified herein.
 - b) Geotextile fabric QPL Certification. In addition to data sheets, provide a written statement from the fabric supplier that the proposed geotextile fabric is included on the current Oregon ODOT QPL list for the geotextile application use proposed or specified (*ie. approved under Table 1, 2, 4 or 5 of OSSC (ODOT/APWA) 02320 for drainage fabric (02320-1), riprap fabric (02320-2), separation fabric (02320-4), or embankment/reinforcement fabric (02320-5) as applicable*).

PART 2: PRODUCTS

2.1 GEOTEXTILE FABRIC

- a. Unless otherwise specified or noted on the drawings, geotextile fabric shall conform OSSC (ODOT/APWA) 02320, Geosynthetics, with minimum property values conforming to 02320 Tables (*see current ODOT QPL list for qualified products*).
- b. Widths shall be as required (*to allow for a minimum seam overlap of 18-inches*), or manufacturer's recommendations, whichever is greater.
- c. Reinforcement Fabric. Unless heavier fabric is specified or noted on the drawings, reinforcement fabric (*for over-excavation or under embankments*) shall be a geotextile fabric included on the ODOT QPL list for OSSC (ODOT/APWA) 02320-5 table (*Embankment [Reinforcement] Geotextile, for woven or non-woven fabric*), generally conforming to the values listed below. Slit film fabrics are not allowed.
 - 1) Minimum values for woven: grab tensile strength of 200 lb; tear strength of 80 lb, puncture strength of 430 lbs; AOS of 30.
 - 2) Minimum values for non-woven: grab tensile strength of 315 lb; tear strength of 110 lb, puncture strength of 620 lbs; AOS of 30.

- d. Separation Fabric. Unless heavier fabric is specified or noted on the drawings, reinforcement fabric (*for over-excavation or under embankments*) shall be a geotextile fabric included on the ODOT QPL list for OSSC (ODOT/APWA) 02320-4 table (*Subgrade [Separation] Geotextile, for woven or non-woven fabric*), generally conforming to the values listed below. Slit film fabrics are not allowed.
 - 1) Minimum values for woven: grab tensile strength of 180 lb; tear strength of 68 lb, puncture strength of 371 lbs; AOS of 30.
 - 2) Minimum values for non-woven: grab tensile strength of 113 lb; tear strength of 41 lb, puncture strength of 223 lbs; AOS of 30.
- e. Drainage Fabric. Unless heavier fabric is specified or noted on the drawings, drainage fabric shall be a geotextile fabric included on the ODOT QPL list for OSSC (ODOT/APWA) 02320-1 table (*Drainage Geotextile, for woven or non-woven fabric*), generally conforming to the values listed below. Slit film fabrics are not allowed.
 - 1) Minimum for non-woven: grab tensile strength of 160 lb; tear strength of 56 lb, puncture strength of 310 lbs; AOS of 40.
 - 2) Minimum for woven: grab tensile strength of 250 lb; tear strength of 90 lb, puncture strength of 495 lbs; AOS of 40.
- f. Riprap Fabric. Unless heavier fabric is specified or noted on the drawings, riprap fabric shall be a geotextile fabric included on the ODOT QPL list for OSSC (ODOT/APWA) 02320-2 table (*Riprap Geotextile, for woven or non-woven fabric*), generally conforming to the values listed below. Slit film fabrics are not allowed.
 - 1) Minimum for non-woven: grab tensile strength of 200 lb; tear strength of 80 lb, puncture strength of 430 lbs; AOS of 40.
 - 2) Minimum for woven: grab tensile strength of 315 lb; tear strength of 110 lb, puncture strength of 620 lbs; AOS of 40.

2.2 PROTECTION

- a. The geotextile shall be furnished in a protective wrapping which shall protect the fabric from ultraviolet radiation and from abrasion due to shipping and handling.

PART 3: EXECUTION

3.1 SURFACE PREPARATION

- a. The surface to receive the geotextile shall be prepared to a smooth condition free of obstructions, depressions and debris.

3.2 PLACEMENT

- a. The fabric shall be placed loosely, not in a stretched condition.
- b. The fabric shall be covered immediately after placement to limit exposure to ultraviolet radiation.
- c. The crushed rock shall be placed so that the geotextile is not punctured.

- d. The maximum drop height for placing crushed rock on the geotextile shall be 3 feet. This specification shall be strictly adhered to so as to avoid damaging the geotextile fabric.
- e. The geotextile fabric shall be installed per plan details.
- f. Transverse joints between fabric panels shall be overlapped for a length in the direction of baserock placement sufficient to prevent movement of the fabric.

PART 4: SPECIAL PROVISIONS

None.

SECTION 02261 GEOSYNTHETIC CLAY LINER

PART 1: GENERAL

1.1 SCOPE

- a. This specification covers the technical requirements for the furnishing and installation of the geosynthetic clay liner shown on the drawings and described herein. All materials used shall meet the requirements of this specification, and all work shall be performed in accordance with the procedures provided herein and the contract documents.
- b. Geosynthetic clay liner material as specified herein shall be used to backfill trenches through the lagoons for the construction of the new lagoon transfer piping as shown on the drawings.

1.2 Definitions

- a. For the purposes of this specification guideline, the following terms are defined below:
 - 1) Geosynthetic Clay Liner (GCL). A manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetics. The GCL may be reinforced or unreinforced as required by site conditions. Slopes steeper than 10H:1V typically require reinforced GCLs.
 - 2) Geomembrane. An essentially impermeable geosynthetic composed of one or more geosynthetic sheets.
 - 3) Geotextile. Any permeable textile used with foundation, soil, rock, earth, or any other geotechnical engineering related material as an integral part of a human-made project, structure or system.
 - 4) Minimum Average Roll Value. The minimum average value of a particular physical property of a material, for 95 percent of all of the material in the lot.
 - 5) Overlap. Where two adjacent GCL panels contact, the distance measuring perpendicular from the overlying edge of one panel to the underlying edge of the other.

1.3 Related Sections

- a. Section 02226 – Trench Excavation and Backfill

1.4 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:

- 1) Conceptual description of the proposed plan for placement of the GCL panels over the area of installation.
- 2) Manufacturer's standard product information.
- 3) A representative sample of the GCL.
- 4) A project reference list for the GCL(s) consisting of the principal details of at least ten projects totaling at least 10 million square feet (100,000 square meters) in size.
- 5) Upon shipment, the Contractor shall furnish the GCL manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the requirements of this specification.

1.5 Qualifications

- a. GCL Manufacturer must have produced at least 10 million square feet (1 million square meters) of GCL, with at least 8 million square feet (800,000 square meters) installed.

PART 2: PRODUCTS

2.1 Geosynthetic Clay liner

- a. The GCLs shall consist of a layer of natural sodium bentonite clay encapsulated between two geotextiles and shall comply with all of the criteria listed in this Section.
- b. All GCLs shall be reinforced.
- c. The GCL material shall have the minimum property values that follow:

Property	Test Method	Test Frequency	Required Values
Bentonite Swell Index	ASTM D 5890	1 per 50 tonnes	24mL/2g min.
Bentonite Fluid Loss	ASTM D 5891	1 per 50 tonnes	18 mL max.
Bentonite Mass/Area	ASTM D 5993	40,000 ft ² (4,000 m ²)	0.75 lb/ft ² (3.6 kg/m ²)
GCL Grab Strength	ASTM D 4632	200,000 ft ² (20,000 m ²)	150 lbs (660 N)
GCL Peel Strength	ASTM D 4632	40,000 ft ² (4,000 m ²)	15 lbs (65 N)
GCL Index Flux	ASTM D 5887	Weekly	1 x 10 ⁻⁸ m ³ /m ² /sec
GCL Permeability	ASTM D 5084	Weekly	5 x 10 ⁻⁹ cm/sec
GCL Hydrated Internal Shear Strength	ASTM D 5321	Periodic	500 psf (24 kPa) typical

- d. A 6-inch (150 mm) overlap guideline shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing quality assurance of the overlap dimension. Lines shall be printed in easily visible, non-toxic ink.

- e. Geosynthetic clay liners shall be Bentomat DN, as manufactured by Northwest Linings & Geotextile Products, Inc., or approved equal.

2.2 Product Labeling

- a. Prior to shipment, the GCL manufacturer shall label each roll, identifying:
 - 1) Product identification information (Manufacturer's name and address, brand product code).
 - 2) Lot number and roll number.
 - 3) Roll length, width and weight.

2.3 Packaging

- a. The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core shall be sufficiently strong to prevent collapse during transit and handling.
- b. All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

2.4 Accessory Bentonite

- a. The granular bentonite or bentonite sealing compound used for seaming, penetration sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer.

PART 3: EXECUTION

3.1 Shipping and Handling

- a. The Contractor shall follow all manufacturer's recommendations regarding shipping, unloading, and storage of the GCL material.
- b. The Owner's representative will visually inspect each roll during unloading to identify if any packaging has been damaged. Rolls with damaged packaging will be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.
- c. All material damaged during shipment or while in storage shall be removed from the jobsite and replaced with new material.

3.2 STORAGE

- a. Storage of the GCL rolls shall be the responsibility of the installer. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry and well-drained.
- b. Rolls shall be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks or by use of the dunnage

shipped between rolls. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

- c. All stored GCL materials and the accessory bentonite shall be covered with a plastic sheet or tarpaulin until their installation.
- d. The integrity and legibility of the labels shall be preserved during storage.

3.3 SURFACE PREPARATION

- a. The surface to receive the geotextile shall be prepared as specified and shall be in a smooth condition free of obstructions, depressions and debris.

3.4 GCL Placement

- a. GCL rolls shall be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL.
- b. No equipment shall be allowed to travel directly on the GCL.
- c. Care shall be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL.
- d. The GCL shall be placed so that seams are parallel to the direction of the slope. Seams should be located at least 3 feet (1 m) from the toe and crest of slopes.
- e. All GCL panels should lie flat on the underlying surface, with no wrinkles or fold, especially at the exposed edges of the panels.
- f. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The project Engineer and GCL supplier should be consulted for specific guidance if premature hydration occurs.

3.5 Seaming

- a. The GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite shall be used for proper seam construction in accordance with the manufacturer's recommendations.
- b. The minimum dimension of the longitudinal overlap should be 6 inches (150 mm). End-of-roll overlapped seams should be similarly constructed, but the minimum overlap should measure 24 inches (600 mm).

- c. Seams at the ends of the panels should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.
- d. Bentonite-enhanced seams shall be constructed between the overlapping adjacent panels. The underlying edge of the longitudinal overlap shall be exposed and then a continuous bead of granular sodium bentonite shall be applied along a zone defined by the edge of the underlying panel and the 6-inch (150 mm) line. A similar bead of granular sodium bentonite shall be applied at the end-of-roll overlap. The bentonite shall be applied at a minimum application rate of one quarter pound per lineal foot (0.4 kg/m).

3.6 Detail Work

- a. The GCL shall be sealed around penetrations and embedded structures embedded in accordance with the design drawings and the GCL Manufacturer.
- b. Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes shall be made to avoid damage to the geotextile components of the GCL during the cutting process.

3.7 Cover Placement

- a. Cover soils shall be as specified in the applicable portions of these specification and shall be from the stockpile areas approved by the Owner's Representative.
- b. Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 1 foot (300 mm) of cover should be maintained between the equipment tires/tracks and the GCL at all times during the covering process.
- c. Soil cover should be placed in a manner that prevents the soil from entering the GCL overlap zones.

PART 4: SPECIAL PROVISIONS

None.

SECTION 02276
DIKE PROTECTION RIPRAP

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing all material, equipment; labor and supervision required to install dike protection riprap where shown on the drawings or specified herein.
- b. All preparatory work and incident work required to properly complete the work shall also be included under this section.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of the Contract Documents and shall include:
 - 1) For the Owner's Representative's review - certification that material conforms to the requirements contained herein.
 - 2) Location of each material source for Owner's Representative's approval.

PART 2: PRODUCTS

2.1 GENERAL

- a. Dike protection riprap shall be sound rock, angular hard, durable, and resistant to weathering. No stone shall have any dimension less than 1/3 its greatest dimension. Rounded stone or boulders will not be accepted.
- b. Apparent Specific Gravity per AASHTO T-85 shall not be less than 2.5.
- c. Percent Absorption per AASHTO T-85 shall not be more than 6 percent (6%).
- d. Riprap shall be free from overburden, spoil, shale and organic material.

2.2 DIKE PROTECTION RIPRAP

- a. In place riprap shall be 5-8 inches open quarry rock.
- b. All riprap shall be screened to conform to the following gradation requirements.

<5"	0-10%
5"-8"	90-100%
>8"	0
- c. All material not conforming to the above specification shall be immediately removed from the site.

PART 3: EXECUTION

3.1 GENERAL

- a. Riprap coverage and thickness shall be uniform.
- b. Riprap shall be placed in areas as shown on the drawings or as directed by the Owner's Representative. No compensation will be allowed for riprap placed outside of the neat areas shown on the plans.

3.2 DIKE PROTECTION RIPRAP

- a. Riprap shall be placed on graded and compacted to the section thicknesses shown on the drawings. Where not shown on the drawings, the minimum rip rap blanket thickness shall be 12-inches.

PART 4: SPECIAL PROVISIONS

None.

SECTION 02360
SHORT AGGREGATE PIERS

PART 1: GENERAL

1.1 WORK INCLUDED

- a. The terms “stone column,” “aggregate pier,” “rammed aggregate pier,” “RAP,” and “short aggregate pier(s)” are considered synonymous for the purposes of these Contract Documents.
- b. In accordance with the Contract Documents, provide all equipment, material, labor and supervision to design and install short aggregate piers for the Intermediate Foundation System for the Headworks, SBR, and Equalization Tank structure. Design shall rely on subsurface information presented in the project geotechnical report which is included as an appendix to these contract documents. Removal of spoils from the site (which result from rammed aggregate pier element construction), footing excavation and subgrade preparation following pier installation are not included.
- c. The final determination of the Rammed Aggregate Pier foundations including depths, special limits in relation to structure footings, and spacing shall be determined by the Contractor’s approved design submittal, with design assumptions verified by a modulus test performed in the presence of an approved by the Geotechnical Engineer of Record. The information presented on the drawings is for illustrative purposes only.
- d. The site will be made accessible to the Bidders and selected Contractor to collect any geotechnical data deemed necessary to complete the Bid and/or Design.
- e. Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 1 Specifications, apply to the work in this section.

1.2 RELATED WORK BY OTHERS

- a. Layout of footings, mats, grade beams and all aggregate pier locations shall be conducted by a qualified surveyor retained by the General Contractor. Survey shall include existing ground surface elevations within 30 feet of each Rammed aggregate pier element. General Contractor assumes full responsibility for any and all costs associated with piers that may be found later to have been mislocated or constructed to the wrong elevation control.
- b. Foundation excavations to expose the tops of aggregate piers shall be made in a workmanlike manner, and shall be protected until concrete placement, with procedures and equipment best suited to (1) preventing softening of the matrix soil between and around aggregate piers prior to pouring structural concrete, and (2) achieving suitable contact between the dense, undisturbed aggregate piers and the concrete footing. Recommended procedures for achieving these goals are to:
 - 1) Limit over-excavation below the bottom of the footing to 3" (including disturbances from the teeth of excavation equipment),
 - 2) Place footing concrete immediately after footing excavation is made and approved, preferably the same day as the excavation, and

- 3) If same day placement of footing concrete is not possible, place a minimum 3" thick concrete seal ("mud mat") immediately after the footing is excavated and approved.
- c. The following criteria shall apply, and a written inspection report sealed by the project geotechnical engineer shall be furnished by the aggregate pier installer to confirm:
- 1) That water (which may soften unconfined matrix soil between and around aggregate piers, and may have detrimental effects on the supporting capability of the pier-reinforced subgrade) has not been allowed to pond in any footing excavation at any time.
 - 2) That all aggregate pier elements designed for each footing have been exposed in the footing excavation.
 - 3) That immediately prior to footing construction, the tops of all aggregate piers exposed in each footing excavation have been inspected and recompact, as necessary, with mechanical compaction equipment; and that the tops of any pier elements which may have been disturbed by footing excavation and related activity have been recompact to a dry density equivalent to at least 95% of the maximum dry density obtainable by the modified AASHTO compaction procedure (ASTM D1557).
 - 4) That any structural fill placed between the tops of aggregate pier elements and the bottoms of foundations consists of the same quality and gradation material, or better, as used in constructing the piers; and that the fill has been compacted to a dry density equivalent to at least 95% of the maximum dry density obtainable by the modified AASHTO compaction procedure (ASTM D1557).
 - 5) That no excavations or drilled shafts have been made after installation of aggregate pier elements within a horizontal distance of 10' from the edge of any pier, without the written approval of the aggregate pier installer.
- d. Failure to provide the above inspection and sealed letter of completion by the project geotechnical engineer confirming product installation is consistent with project requirements, will constitute incomplete installation and delivery of the product.
- e. All above and below ground utilities shall be located, clearly marked, and relocated as necessary prior to installation of aggregate pier elements.

1.3 APPROVED INSTALLERS

- a. Installers of Rammed Aggregate Pier foundation systems shall have a minimum of 5 years of experience with the installation of Rammed Aggregate Pier systems and shall have completed at least 30 projects.
- b. The Rammed Aggregate Pier Installer (the Installer) shall be approved by the Geotechnical Engineer of Record. Installers currently approved for these works are as follows:
 - 1) Geopier-Northwest, Inc., Bellevue, WA

- 2) Keller North America, Inc., Portland, OR
 - 3) Geotech Foundation Company West, Hillsboro, OR
 - 4) Malcolm, Kent, WA
- c. Without exception, no alternate installer will be accepted unless approved by the Geotechnical Engineer of Record and must meet the experience qualifications noted above.

1.4 QUALITY ASSURANCE

- a. The installer of the rammed aggregate pier system shall have a full time Quality Control representative on site to verify and report all QC installation procedures. This work shall be conducted under the supervision of a registered professional engineer licensed in the State of Oregon and retained by the installer of the rammed aggregate pier system. A testing agency or geotechnical engineer may be retained by the Owner for Quality Assurance services, but does not relieve the contractor of having a full time QC representative on site.
- b. The installer of the rammed aggregate pier system shall provide and install all test dial indicators and other measuring device and shall conduct tests as required.
- c. The testing agency/geotechnical engineer, may monitor installation procedures. The installer shall strictly adhere to all methods, standards, and codes described in this specification.
- d. A Daily Aggregate Pier Progress Report shall be completed during each day of installation including information as follows:
 - 1) Date of installation and summary of installation equipment and installation procedures.
 - 2) The pier location, length, and diameter.
 - 3) Final elevations of the pier top and bottom.
 - 4) Average lift thickness.
 - 5) Documentation of any unusual conditions encountered.
 - 6) Description of soil and groundwater conditions.
- e. The installer of the Rammed aggregate pier system shall provide evidence of satisfactory experience with the design and installation of rammed aggregate pier systems. The installer of the rammed aggregate pier system shall have completed the minimum qualifications described above. A listing of the relevant projects shall be included in the qualification submittal described below. The design and installation shall be conducted and supervised by a registered professional engineer licensed in the State of Oregon. The proposed engineer for this project shall be included in the submittal package listed below.
- f. The designer of the Rammed aggregate pier system shall carry Errors and Omissions Insurance with coverage of at least \$3 Million per occurrence.
- g. A calibrated dynamic penetration test (ASTM STP 399) shall be performed on representative Rammed aggregate pier elements. A minimum of 15 blows per 1.75 inch vertical movement shall be the minimum average penetration resistance of compacted, graded aggregate base course stone.

1.5 REFERENCES

- a. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1)	ASTM D1143	Pile Load Test Procedures
2)	ASTM D1194	Spread Footing Load Test
3)	ASTM D1557	Aggregate Densification
4)	ASTM D1241	Aggregate Quality
5)	ASTM STP 399	Dynamic Penetrometer Testing
6)	ASTM D3689	Uplift Load Test

1.6 SUBMITTALS

- a. Make submittals in accordance with requirements of Division 1 and as specified in this section.
- b. Qualifications information for the rammed aggregate pier installer demonstrating compliance with the minimum qualifications listed above.
- c. Design Submittal - The Installer/ Designer shall submit detailed design calculations, construction drawings, and shop drawings for review and comment by the Geotechnical Engineer of Record (GER) at least 4 week(s) prior to the beginning of construction. GER will confirm geotechnical design parameters and design approach are consistent with the project Geotechnical Report and intent of installation and note exceptions. The GER will not substantiate or approve design calculations, nor relieve the rammed aggregate pier design engineer of design responsibility by means of review approval. The design submittal shall include, among other specifics, the gradation specifics of the intended aggregate and drawings identifying the criteria used to calculate the intended aggregate volume (pier depth, nominal pier diameter, number of piers). A detailed explanation of the design parameters for settlement calculations shall be included in the Design Submittal. Additionally, the quality control test programs for Aggregate Pier system, meeting these design requirements, shall be submitted. All calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the State of Oregon.
- d. Modulus Test Reports – A modulus test(s) performed on a non-production Rammed Aggregate Pier element shall be required by designer to verify design assumptions. Installer shall furnish the General Contractor (Contractor) a description of the installation equipment, installation records, complete test data, analysis of the test data and verification of the design parameter values based on the modulus test results. The report shall be prepared under direction of a Registered Professional Engineer licensed in the State of Oregon. The Owner's Engineer shall be notified a minimum of 1 week prior to performing the modulus test and the test shall be performed in the presence of the Geotechnical Engineer of Record.
- e. When load tests are authorized, the installer shall furnish within 5 days of the completion of the test, a complete report including a description of the installation equipment, installation records, complete test data, analyses of the test data, and recommended design parameters based on the load test results. The report shall be prepared by or under the direct supervision of a registered professional engineer experienced in modulus testing, performance and analysis of the Rammed aggregate pier system.

- f. Daily Aggregate Pier Progress Report, a complete and accurate record of the aggregate pier installation conforming to the requirements listed above, shall be furnished to the Engineer.

1.7 RAMMED AGGREGATE PIER DESIGN

- a. The rammed aggregate pier system shall be designed in accordance with generally accepted engineering practice. The design life of the structure shall be 50 years.
- b. The design shall be based on the following static loading from the structure:
 - 1) Footings (wall and columns): 2000 psf
 - 2) Floor slab minimum loading between footings: 1800 psf
- c. The design shall meet the following criteria:
 - 1) Estimated Total Long-Term Settlement for Foundations (column and exterior wall footing): ≤ 1.5 -inch
 - 2) Estimated Long-Term Differential Settlement: ≤ 0.5 -inch in 50 feet
- d. The rammed aggregate pier elements shall be designed and installed with a minimum area replacement ratio of 13 percent and a minimum 2,000 cubic yard volume of installed aggregate or as approved by the Engineer and Owner.
- e. The rammed aggregate pier elements shall be designed using a stiffness modulus to be verified by the results of the modulus test described in these specifications.
- f. The rammed aggregate pier design submittal shall be accompanied by a proposal from the Contractor detailing a method of short term settlement performance verification. The verification method shall include reference points on both the walls and top of structure. Examples of potential reference points include but are not limited to the following:
 - 1) Wall reference points could be studs placed in the tank wall exterior--one on each side of the SBR tankage (north, south, east, and west) at an elevation and location which will be accessible after construction.
 - 2) Top slab reference points could be pins cast into the concrete walkways spaced around the perimeter of the structure.

The verification method shall include establishing a baseline elevation for each point after tank construction but before initial filling.

The verification method shall include a loaded condition reading after the tank structure is online (full of water, in use by the City). Total settlement of each point shall be calculated. Differential settlement of each point relative to each other point shall be calculated.

The approved method shall be performed by the Contractor and reported to the Engineer. If short-term performance shows settlement exceeding the estimated long-term performance criteria listed above, the Rammed Aggregate Pier system will be considered out of compliance and will entitle the Owner to an additional one year of warrantee period applying to the tankage and any utility within 50 feet of the tankage.

1.8 DELIVERY, STORAGE, AND HANDLING

- a. Any materials ordered or delivered to the project site before approval will be at contractor's risk.
- b. Deliver materials to project site in quantities and at times to assure conformity of activities with the installation schedule for the Rammed aggregate pier system.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Aggregate for the piers shall consist of materials that are in general conformance with gradation requirements for State DOT highway base course and/or drainage materials. During wet weather conditions, the aggregate shall contain less than 5 percent fines (silt and clay particles passing the No. 200 sieve). The Rammed aggregate pier installer shall make the determination of acceptable materials to be used in pier construction.
- b. A suitable washed graded aggregate may be used in wet conditions or as initial lifts where soft soils are present at the bottom of the aggregate pier.
- c. Potable water or other suitable source shall be used to increase aggregate moisture content as needed for workability. Water shall be made available on-site to the installer of the Rammed aggregate pier system for their use in moisture conditioning aggregate for compaction, as needed. The need for moisture conditioning aggregate shall be made by the Rammed aggregate pier installer based workability and/or dust control; however, moisture content of aggregate is not a requirement for pier acceptance.

PART 3: EXECUTION

3.1 INSPECTION

- a. Examine areas and conditions under which short aggregate piers are to be installed.
- b. Notify Owner's Representative of conditions detrimental to proper and timely completion of Work.
- c. Do not proceed with Work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 PREPARATION

- a. The General Contractor shall locate and protect underground and above ground utilities, and other structures from damage during installation of the Rammed aggregate pier system.
- b. Install Rammed aggregate pier elements after Earthwork in area has been completed as follows:
 - 1) Site subgrade established by General Contractor within 6 inches of finish subgrade, or as approved by installer of the Rammed aggregate pier system.

- 2) Fills placed to subgrade (unless provision is made in the Rammed aggregate pier design for grading fills placed over the Rammed aggregate pier-reinforced subgrade).
- 3) A working surface established by General Contractor to provide wet weather protection of subgrade and to provide a base for efficient operation of pier installation equipment.

3.3 INSTALLATION

- a. The locations, size, and spacing of the rammed aggregate pier system shall be described on the appropriate drawings or details submitted by the designer and review by the Geotechnical Engineer of Record. Any modifications in size and spacing of rammed aggregate pier element layout shall require approval by the system designer prior to modified installation.
- b. Should any obstruction, including but not limited to boulders, timber, concrete, asphalt, large roots etc., be encountered which prevents placing the elements to the required depth, or causes the aggregate pier to drift from the required location, the obstruction shall be removed. The excavation shall be with suitable materials and sufficiently compacted, in order to continue with installation of the aggregate pier. Aggregate piers may be terminated short of design depth on rock, gravel or other suitable materials. Additional aggregate piers shall be installed when required by the presence of obstacles as determined by the designer.
- c. The bottom of the pier excavation shall be compacted prior to the placement of aggregate. If wet, soft or sensitive soils are present, open graded aggregate shall be placed and compacted to stabilize the pier bottom and may serve as the initial pier lift.
- d. The center of each aggregate pier shall be within 6 inches of the planned location indicated. Foundation elements installed outside of the above tolerance and deemed not to be acceptable, shall be rebuilt at no additional expense to the Owner. Other remedial measures may be used as approved by the designer.

3.4 RAMMED AGGREGATE PIER ELEMENT MODULUS TESTING

- a. Modulus tests on Rammed aggregate pier element(s) are required and shall be of the type and installed in a manner specified herein. Modulus test data shall be used by the Rammed aggregate pier system designer to confirm Rammed aggregate pier element design parameters for the project.
- b. Rammed aggregate pier elements used for modulus testing which are located within tolerance and provide a safe design capacity may, upon approval of the Rammed aggregate pier system designer, be used in the finished work.
- c. Compressive load test procedures shall be conducted in general accordance with ASTM D1143 and D1194, as appropriate. A test pier shall be loaded to 150 percent of the estimated element design pressure. Alternatively, at the discretion of the Rammed aggregate pier designer, the modulus test may be terminated when a modulus equal to 150 percent of the modulus used in the design is achieved.

- d. The modulus test shall be conducted as follows:
- 1) ASTM D1143 general test procedures shall be used as a guide to establishing load increments, load increment duration, load increments, and total applied load.
 - 2) With the exception of the load increment representing approximately 112% of the design maximum Rammed aggregate pier element stress, all load increments shall be held for a minimum of 15 minutes, a maximum of 1 hour, and until the rate of deflection reduces to 0.01 inch per hour, or less.
 - 3) The load increment which represents approximately 112% of the design maximum Rammed aggregate pier element stress shall be held for a minimum of 15 minutes, a maximum of 4 hours, and until the rate of deflection reduces to 0.01 inch per hour, or less.
 - 4) A seating load equal to 5 percent of the total load shall be applied to the loaded steel plate prior to application of load increments and prior to measurement of deflections to compensate for surficial disturbance.
- e. Modulus test information shall be used to verify Rammed aggregate pier system settlement design. The design shall be consistent with the values computed as follows:
- 1) The maximum bearing pressure of the footing/mat bottom shall be calculated as follows:
 - DBP = the Design Bearing Pressure for the Rammed aggregate pier supported footing,
 - A = (project design settlement) - (estimated settlement attributable to the lower zone),
 - B = the actual deflection of the Rammed aggregate pier element from the modulus test, measured at the design vertical Rammed aggregate pier element stress intensity,
 - Maximum Allowable Composite Bearing Pressure = $DBP (A/B)$
 - 2) A Rammed aggregate pier element and its representative footing bottom segment may support the maximum load equal to the bearing pressure defined above times the area of the footing segment supported by one Rammed aggregate pier element. Maximum load shall include 100% dead load and that portion of live load allowed by appropriate building code. Unless otherwise specified in writing, the portion of live load included in total load calculation shall be 40% of the live load.

3.5 RAMMED AGGREGATE PIER ELEMENT UPLIFT TESTING

- a. When field uplift tests are performed on Rammed aggregate pier elements, ASTM D-3687 shall serve as a basis. Uplift deflections shall be measured for both the reaction plate installed at the bottom of the Rammed aggregate pier element shaft and for a steel plate installed at the top of the element. Dial gages accurate to at least 0.001" shall be used and shall be supported on independent reference supported beams. Unloading decrements shall be in at least four equal decrements, if possible.

- b. The following procedure shall be followed in performance of field tests to confirm uplift design parameters for Rammed aggregate pier elements, as required.
- 1) Apply a seating load not to exceed 3 kips.
 - 2) Zero dial gages following application of seating load.
 - 3) Apply load in equal increments of 5 kips each, with a maximum of 8 increments between the seating load and the element design load. Record deflections at each load increment.
 - 4) Unload to the initial seating load in 4 equal increments, and record rebound for each increment.
 - 5) Re-apply load in same increments used for the initial load cycle to at least 1.5 times the design load for the Rammed aggregate pier element, and record deflections
 - 6) Unload in the same increments used for the initial unloading, and record rebound for each increment.
- c. For tests conducted to evaluate performance under sustained uplift conditions (such as hydrostatic), each load shall be maintained for a minimum of 10 minutes and until the rate of deflection equals 0.01 inch per hour, or less. For tests used to evaluate uplift performance under short term loading (such as wind or seismic), each load shall be maintained for a minimum of 5 minutes.
- d. The deflections recorded for each plate shall be averaged, and a load vs. deflection curve plotted for the top plate and the bottom plate. The ultimate uplift load for the Rammed aggregate pier element shall be defined as the load at which the rate of deflection measured at the top of the element is approximately equal to the rate of deflection at the bottom of the element.
- e. The allowable uplift load for the tested Rammed aggregate pier element shall be defined as follows:
- 1) Two-thirds of the load at which the slope of the load vs. deflection curve at the top of the element becomes equal to or greater than 90% of the slope of the load vs. deflection curve for the bottom of the element.
 - 2) the maximum allowable load shall not be greater than the load corresponding to a total deflection at the bottom of the element of 1.0".

PART 4: SPECIAL PROVISIONS

None.

SECTION 02502
CONCRETE SIDEWALKS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the construction of concrete sidewalks as shown on the drawings, specified herein or directed by the Owner's Representative.

1.2 SUBMITTALS FOR OWNER'S REPRESENTATIVE'S APPROVAL

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the following:
 - 1) Manufacturer's or supplier's certificates stating that the following conform to the specifications contained herein.
 - a) Joint Sealer
 - b) Preformed Filler
 - c) Curing Materials
 - d) Air Entraining Agents

PART 2: PRODUCTS

2.1 GENERAL

- a. Baserock shall conform to the requirements of OSSC (ODOT/APWA) 02630, Base Aggregate, for 3/4"-0 dense graded aggregate.
- b. Other materials required for placing concrete shall be as follows:
 - 1) Preformed Filler
 - a) Fiber Filler ASTM D1751
 - b) Sponge Filler ASTM D1752, Type I
 - 2) Curing Materials
 - a) Burlap Cloth AASHTO M-182, Class 2.
 - b) Sheet Materials ASTM C171
 - 3) Plastic sheeting shall be visqueen with a minimum thickness of 5 mils.

2.2 CONCRETE (CAST-IN-PLACE)

- a. All concrete used shall conform to the requirements of OSSC (ODOT/APWA) 00440, Commercial Grade Concrete, 3300 psi, with Type 1 or Type 1-D clear curing compound.

PART 3: EXECUTION

3.1 GENERAL

- a. All soil subgrade under driveways, curbs, curb and gutter and walks shall be compacted in accordance with the requirements of these Contract Documents.
- b. Unless greater depths are shown on the drawings or details, a minimum two (2)-inch granular baserock leveling course shall be provided under all walks.
- c. All sidewalks shall conform to the lines, grades and details shown on the drawings or modified in the field by the Owner's Representative. The top and face of structures shall be true and straight, free from humps sags or other irregularities. The surface shall not vary more than 0.02 feet from the edge of 12-foot long straightedge laid on the top or face of the structure, except in curves. Contractor shall furnish the straightedge and operate it as directed. Unless otherwise shown or directed, all edges shall be tooled to 1/4-inch radius.
- d. Unless otherwise specified, shown or directed, sidewalks, driveways, stairs, etc., shall conform to the requirements of OSSC (ODOT/APWA) Section 00759, Miscellaneous Portland Cement Concrete Structures, including placement, curing and finishing.
- e. Concrete surfaces shall be finished smooth and uniform in texture by troweling, floating and cross brooming. Groove or mark surfaces into squares or other shapes as shown or directed.
- f. Forms
 - 1) Forms, if any, shall be removed from structures after the concrete has taken its initial set and while the concrete is still green. Plastering on exposed surfaces is prohibited.
 - 2) Approval of forms does not relieve Contractor from the responsibility of settings forms per plan requirements.
- g. Heavy construction vehicles shall not operate on any new pavement or sidewalks. Contractor shall keep the concrete structures free from contact, strain and public traffic for at least seven (7) calendar days or as directed by the Owner's Representative.
- h. No concrete shall be mixed, transported, placed, or finished when the temperature of the base, subgrade, or air is below 40°F or whenever, in the opinion of the Owner's Representative, the temperature may fall below 40°F within 24 hours after the concrete has been placed. The Contractor shall protect newly placed concrete from freezing for no less than seven (7) days.
- i. The Contractor shall take such precautions as are necessary to protect newly placed concrete from rain.

3.2 SIDEWALKS AND DRIVEWAY APRONS

- a. All sidewalks shall be a minimum of four (4)-inches thick. Unless thicker sections are noted or shown on the drawings.
- b. Expansion joints shall be constructed using ½-inch thick preformed filler at all fixed structures or buildings, and at a maximum spacing of forty-five (45) feet.
- c. Contractor shall lay out and construct contraction joints in all sidewalk and driveway surfaces in squares or orthogonal shapes with a length to width ratio not to exceed 1.25:1. In no case shall concrete joint spacing exceed 15 feet. Additional joint lines shall be provided as necessary at all building corners, bench supports, seat wall corners, roof columns, raised planter corners, retaining wall corners, etc. Contraction joints shall be tooled to separate the aggregate through at least 75% through the thickness of the sidewalk or gutter to control cracking to contraction joint locations. Cracking between contraction joints shall not be acceptable, and shall be removed and replaced as directed by the Owner's Representative at no additional cost to the Owner.
- d. Sidewalks shall conform to the following.
 - 1) Direction of sidewalk cross slope shall conform with to the slopes shown on the grading plan.
 - 2) Longitudinal slope shall not exceed 1:20 (5%) without approval from the Owner's Representative (ADA rules require handrails on slopes greater than 5%, except at ADA ramps).
 - 3) Sidewalk cross slope shall not exceed 1:67 (1.5%), and sidewalks shall have a minimum slope of 1.0% to drain.
- e. The Contractor shall notify the Owner's Representative or Owner and allow them the option of inspecting sidewalk forms prior to concrete placement. It shall remain the contractor's responsibility to verify that sidewalks match both design widths and grades prior to placement. Inspection by the Owner or the Owner's Representative does not relieve the contractor of his responsibility to construct the sidewalks in accordance with the approved construction drawings and the tolerances outlined above.
- f. Place topsoil backfill adjacent to new curb and dress back disturbed area.

PART 4: SPECIAL PROVISIONS

None

SECTION 02510
HOT MIXED ASPHALT CONCRETE (HMAC) PAVEMENTS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the construction of hot-mix asphalt concrete pavements (ACP) as shown on the drawings, specified herein or directed by the Owner's Representative. As used herein, HMAC refers to ACP as defined in the Oregon OSSC.
- b. This section includes the construction of one or more courses of AC pavement, adjustment of manhole castings, catch basins, junction and valve boxes, etc. to conform to new pavement courses, and other work and materials incidental to the construction of pavements.
- c. This section includes cutting and preparation of joints where new paving will meet existing paving.
- d. This section includes repaving disturbed asphalt concrete driveways to equal the original condition and blend-in to match drop curbs.

1.2 LABORATORY SERVICES

- a. Unless otherwise specified or shown on the drawings, Owner may provide laboratory services by an approved independent laboratory as described below or as noted on the drawings. The Contractor shall be responsible for obtaining & providing all samples requested by the Owner or as required to complete the work. Contractor shall notify Owner's Representative prior to all testing, to allow the Owner's Representative to be present during testing if desired.
 - 1) A compaction test shall be performed for every 50 tons of material placed, or a minimum of one test per lift for each 100 linear feet of street, whichever is greater.
 - 2) The laboratory shall provide a satisfactory certificate furnished by the manufacturer stating that the bituminous materials conform to OSSC (ODOT/APWA) 00744, hot-mixed Asphalt Concrete Pavements (ACP).
 - 3) Asphalt Concrete:
 - a) Plant Certification: The laboratory shall certify or furnish recent certification (within one year) from the ODOT that the plant meets State requirements.
 - b) Plant Inspection: For the first day of production and for every day when more than 200 tons of material is being delivered to the project, the laboratory shall provide a representative at the plant who will inspect the plant, make mix design adjustments, check the temperature and take the required samples.
 - c) Quality Control Testing: Each day the laboratory representative is on the project, a sample of the mix shall be taken for each 400 tons of bituminous

material or fraction thereof delivered to the project. An extraction test AASHTO T16470 and a mechanical analysis AASHTO T-3070 shall be performed on the mix samples.

1.3 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) Submittals for Review. Submittals shall include but not limited to the following:
 - a) Certification that bituminous material conforms to the requirements contained herein.
 - b) HMAC mix designs.
 - 2) Submittals for Record. In addition to the Owner's Representative, copies of all field test reports shall be provided to all other jurisdictions with authority over right-of-way where trench backfill work is occurring (ie. City, County, ODOT, etc.).
 - a) Laboratory test results (as applicable).
 - b) Field compaction test results.

PART 2: PRODUCTS

2.1 TACK COAT

- a. Edge Tack: The tack coat material where new ACP abuts sawcut edges, grind edges, curbs or structures shall be CSS-1, or CSS1h, and shall meet the requirements of OSSC (ODOT/APWA) Section 00730, Emulsified Asphalt Tack Coat.
- b. Overlay Tack: Hot oil tack coat shall be used prior to placement of the overlay fabric for AC overlays (*same type of hot oil material as used in the AC pavement mix*).

Use of emulsion tack coats shall be prohibited with overlay fabric.

2.2 JOINT SEAL

- a. The joint seal shall meet the test requirements of ASTM D-244.
- b. The joint seal material shall be CRS-1, CRS-2 or approved equal and shall meet the requirements of OSSC (ODOT/APWA) Section 00730, Emulsified Asphalt Tack Coat, for cationic emulsified rapid setting asphalt.

2.3 BITUMINOUS MATERIAL AND ASPHALT CONCRETE

- a. Bituminous Material: The asphalt cement shall be PG 64-22 and shall meet the requirements of OSSC (ODOT/APWA) 00744.11, Asphalt Cement & Additives.

b. Design Mix:

- 1) AC pavement shall meet the requirements of OSSC (ODOT/APWA) 00744, hot-mixed Asphalt Concrete Pavements (ACP), 3/4" dense graded mix (base course) or 1/2" dense graded mix (leveling or wearing course) as summarized below. Where noted on the drawings, Class B pavement refers to the 3/4" dense graded mix, and Class C refers to 1/2" dense graded mix.
 - a) Unless otherwise identified on the drawings, AC pavement shall be Level 2 Job Mix Formula (JMF).

2.4 JOINT/CRACK SEAL FABRIC

- a. Where specified or noted on the drawings or details, joint seal fabric shall be self-adhering, non-woven geotextile paving fabric product with rubberized mastic adhesive and pre-tacked (*ie. asphalt tack coating on top to ensure strong bond with pavement*), and specifically designed for paving.
- b. Unless wider widths are specified on the drawings, all joint/crack seal fabric shall be provided in rolls with a minimum width of 18-inches.
- c. Joint/crack seal fabric shall be self-adhesive paving fabric, PetroTac or Mirafi MTK or approved equal.

PART 3: EXECUTION

3.1 GENERAL

- a. All soil subgrade and crushed rock base under pavements and driveways shall be compacted in accordance with the requirements of these Contract Documents.
- b. All valve and service boxes, manholes, inlets, clean outs, junction boxes and other structures shall be adjusted or reconstructed to the finish grades in both new and resurfaced pavement areas.
- c. It shall be the Contractor's responsibility to notify all residents a minimum of two (2) business days prior to paving a street section and to assure that vehicles are removed from street areas prior to paving operations.

3.2 PROTECTION

a. Asphalt Pavements:

- 1) Bituminous mixtures shall be placed only when the surface is dry and weather conditions are such that proper handling, finishing and compaction can be accomplished. In no case shall bituminous mixtures be placed when the surface temperature is below the minimum established below:

<u>Course Thickness</u>	<u>Min. Surface Temperature</u>
Less than 1½-inch	60°F ^{1,2}

1½-inch to 2½-inches	50°F ^{1,2}
Over 2½-inches	45°F ^{1,2}

¹ - If placing ACP between March 15 and September 30, surface temperature requirements may be lowered by 5°F if approved by the Owner's Representative.

² – Use of field burners or other devices to heat existing pavement surfaces to the minimum temperatures is prohibited.

2) Traffic shall be prohibited on newly installed asphalt pavement until it has cooled sufficiently to avoid marking.

b. No heavy construction vehicle shall operate on any finished pavement surfaces.

3.3 SITE PREPARATION

- a. Unless otherwise specified or directed by the Owner's Representative, edges of existing pavements shall be saw cut in a neat manner wherever new pavement will join existing pavement.
- b. Private utility companies shall be advised of Contractor's construction schedule so their surface appurtenances can be adjusted by them to finished grade prior to commencement of paving operations.
- c. Tack Coat. Tack coat material shall be liberally applied to all joints with existing pavement, manhole frames, catch basins, curbs, etc., shortly prior to paving as specified herein.
- d. Paving over Existing Baserock. Existing aggregate baserock, when specified on the plans to remain in place, shall be scarified to a minimum depth of 6-inches, moisture conditioned, graded and compacted as specified herein prior to placement of additional aggregate HMAC pavement.

3.4 PAVEMENT INSTALLATION

- a. All construction shall be in conformance with applicable portions of OSSC (ODOT/APWA) 00744, hot mixed Asphalt Concrete Pavements (ACP), except as modified herein.
- b. Time Limit from Tack Coat Installation. First course shall be placed to the compacted thickness shown on the drawings within two (2) hours of applying tack coat.
- c. Time Limit between Lifts. Wearing course shall be placed to the compacted thickness shown on the drawings within two (2) hours of completing the placing and compacting the first course. If the wearing course is not placed within the time frame specified, a hot oil tack coat shall be applied prior to placement of the wearing course.
- d. Temporary Edges. In the event that full width paving is not completed in one work day, the Contractor shall place signs warning the motorists of abrupt edges. Takeoffs and ends of pavement panels unable to be completed shall be temporarily ramped at the rate of one (1) inch rise per six (6) horizontal feet at the end of the workday and signing placed warning the traffic.

- e. HMAC Temperature. Contractor shall be responsible for transporting AC mix in a manner to maintain the minimum placement temperatures as specified under OSSC (ODOT/APWA) 00744, Asphalt Concrete Pavement (ACP), section 00745.43.b. Standard minimum AC temperature behind the paver (or immediately after placement if hand spread) is 240°F.

3.5 PAVEMENT JOINTS/SEAM LOCATIONS

- a. Per OSSC 744.44, place ACP in panel widths to minimize the number of longitudinal joints to a minimum.
- b. For multi-lift paving, offset the longitudinal and/or transverse joints in one panel by at least 6-inches from the joints in the panel immediately below (OSSC 744.44.a).
- c. Longitudinal pavement panel joints/seams shall be at or within 6 inches of the centerline of the street unless otherwise approved by the Owner's Representative and agency with jurisdiction. Joints offset from centerline shall be installed at or within 6 inches of lane lines or fog lines. In no case shall longitudinal pavement joints be allowed in travel lanes or adjacent to travel lane wheel paths.
- d. Where pavement stripping is shown on the drawings or specified, longitudinal joints in the wearing (top) course shall be offset approximately 6-inches from the design stripping location.
- e. All pavement joints shall be tack coated prior to paving (except for joints between adjacent pavement panels installed on the same day within the time limits specified herein).

3.6 LINES AND GRADES

- a. Lines and grades shall conform accurately to lines and grades shown on the drawings and as staked in the field. Tolerance on grade shall be 3/8-inch on a 16-foot straightedge at any point.
- b. Surface Tolerance: The top surface of the finished pavement shall be uniform in texture, smooth and conform to the specified crown and grade. The top surface of the asphalt concrete pavement shall not vary more than 0.02 feet (1/4-inch) when tested by a 12-foot straightedge. Job control testing shall be performed with a 12-foot straightedge furnished and operated by the Contractor. The Owner's Representative or his authorized representative shall be notified so that they can observe this testing, or may require additional testing to be performed if they are not so notified. Any surface irregularities exceeding the above tolerances shall be corrected by the Contractor at no additional cost to the Owner.
- c. Finish pavement grades at transition to existing pavement shall match existing pavement grades or be feathered past joints with existing pavement as required to provide a smooth, free draining surface.

3.7 FINISH AND COMPACTION

- a. Pavement surface shall be a smooth, well sealed, tight mat. Bony or open graded pavement

surfaces shall be repaired to the satisfaction of the Owner's Representative, prior to final acceptance of the work.

- b. Contractor shall protect new pavement against traffic as required herein, until it has cooled sufficiently to avoid tracking.
- c. Compaction for asphalt concrete pavement shall be a minimum of ninety-one percent (91%) at all locations for standard duty mix as determined by the Rice Standard Method (AASHTO T-29). A roller pattern shall be established by the Contractor to achieve the required compaction at the beginning of the paving process. The roller pattern and compaction tests results from an independent testing lab retained by the Owner may be used to verify compaction.
- d. Contractor shall adjust the rate of AC placement as required to allow AC temperatures to be maintained as required to achieve compaction before the temperature drops below the limits specified under OSSC 00744.49.

3.8 JOINT SAND SEAL

- a. Tack coat and sand seal shall be installed at all pavement joints.
- b. Tack coat and sand seal shall be installed as required to completely seal any sawcuts which extend beyond the limits of pavement removal. Sawcuts shall be cleaned out as required to allow for penetration of tack coat for the full depth of the sawcut.
- c. Excess sand shall be removed from the surface after the sand seal has set up.

3.9 AC PAVEMENT DRIVEWAYS

- a. Disturbed asphalt concrete driveways shall be reconstructed as specified to existing or better conditions, using materials specified for AC pavements.
- b. Existing asphalt concrete driveways shall be reconstructed as specified or shown on the Drawings, using materials specified for AC pavements.

3.10 AC PAVEMENT LIMITS FOR FENCED SITES

- a. Unless otherwise specifically shown on the drawings or otherwise specified, where pavement is shown installed on the interior side of fenced sites, the AC pavement shall extend a minimum of 3 inches beyond the fence alignment, with the fence posts installed after placement & compaction of the pavement along the fenceline *(to allow the concrete around the fence posts to be crowned slightly to direct surface drainage away from the post)*.

PART 4: SPECIAL PROVISIONS

None.

SECTION 02605
PRECAST CONCRETE VAULTS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing precast concrete vault(s) of types and at locations shown on the drawings and scheduled.
- b. This section includes excavation for vault construction, Portland cement mortar, precast concrete integral base sections, transition sections, frames and covers, making watertight connections to new piping and other work incidental to vault construction and testing.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) Shop drawings.
 - 2) Hatch details.
 - 3) Manufacturer's literature and certification for review purposes.

PART 2: PRODUCTS

2.1 VAULT

- a. Vault shall be a precast vault as shown on the drawings as manufactured by Oldcastle Precast or approved equal.
- b. All vaults shall meet or exceed ASTM C-857. All concrete shall be 4500 psi at 28 days. All rebar shall be ASTM A-615 grade 60.

2.2 ACCESS HATCHES

- a. Hatch arrangement shall be as shown on the drawings. Size and clear opening shall be as shown on the drawings. Unless otherwise specified, all hardware shall be stainless steel.
- b. Each hatch shall be designed to combine covering of the opening, fall through protection per OSHA standard 1910.23 and controlled confine space entry per OSHA standard 1910.146. Material shall be 6061-T6 aluminum for bars, angles and extrusions, and 1/4" diamond plate shall be 5086 aluminum.
- c. Hatch rating (traffic or non-traffic) shall be as noted on the drawings or below. Non-traffic hatches shall be pedestrian rated for 300 PSF loading. Traffic rated hatches shall be AASHTO H-20 load rated (no subject to high density traffic). Load calculations shall be submitted, with deflection not to exceed 1/150th of the span
- d. The hatch cover leaf shall be 1/4-inch aluminum diamond pattern plate reinforced with aluminum stiffeners completely around the perimeter and as required to prevent distortion of the leaf when in any position.

- e. Hatch shall be provided with channel frames as noted below.
 - 1) Channel Frames: Channel frames shall have an anchor flange around the perimeter, and shall be provided with two 1½-inch drain coupler to the exterior of the vault top slab (one each end), allowing the channel to be completely drained. Vault shall be fabricated with a drain pipe extended from the drain coupler to the exterior of the hatch concrete top. The drain pipe shall be aluminum, stainless steel, or schedule 80 PVC.
- f. Hatch doors shall be equipped with the seal gasket kit manufactured by Syracuse castings, or approved equal.
- g. The hatch frame shall be provided with a full depth aluminum skirt (¼-inch minimum thickness) which extends the full depth of the vault top slab (aluminum plate to act as concrete form, with skirt to be flush with the inside face of the hatch frame, and welded around the perimeter or integral with hatch frame).
- h. The exterior of hatch frame and skirt (in contact with concrete) shall be supplied with a 3-mil thickness of “Tufcoat 3.5 PR” Industrial Coating by Dupont. Application procedure shall be in accordance with manufacturer.
- i. Hinges shall be of heavy-duty design. Material shall be stainless steel with a 3/8” grade 316 stainless steel pin. Hinges shall be bolted to the channel frame and diamond plate, with grade 316 stainless steel bolts and ny-lock nuts.
- j. Hatch covers shall be equipped with a recessed cast aluminum handles. Lift handles must be placed at outer edges of cover. The lift handles shall be flush with the top of the 1/4” diamond plate.
- k. Hatch covers shall be supplied with a grade 316 stainless steel recessed Slamlock, with keyway protected by a threaded stainless steel plug. Plug shall be flush with the top of the ¼” diamond plate. Slamlock shall be fastened with four grade 316 stainless steel bolts and washers.
- l. Hatch covers shall be supplied with a Recessed Padlock Clip (RPC). RPC shall be supplied with its own separate hinged cover for owner access to the owner supplied padlock. The separate hinged cover MUST be supplied with a spring-loaded cover so that there is no possibility of the cover being left in the “open” position, which would cause a trip hazard.
- m. Hatch covers shall be equipped with a stainless steel hold open arms. To highlight the hold open arm feature, the entire hold open arm must be supplied with a “red” powder coat finish. Any hold open arm not supplied with red powder coat finish shall not be accepted as equal. Covers shall automatically lock open in the 90-degree position. Hold open arms shall be fastened to the frame with a 1/2” grade 316 stainless steel bolt.
- n. Hatch covers shall be supplied with a heavy duty, stainless steel pneumatic-spring. Spring must consist of a minimum ½” stainless steel shaft which slides into a minimum 1” stainless steel tube. Spring must be charged with an inert gas (nitrogen). Mechanical, torsion, or coil type springs shall not be accepted as equal. Spring design must ensure

ease of maintenance, including being able to removed/replaced by removing no more than three bolts.

o. Safety Hatch Fall Protection

- 1) Where noted on the schedule below, hatches shall be equipped with a safety grating system in accordance with the following specifications.
- 2) Each hatch shall be provided with an integral safety grate that provides fall through protection per OSHA standard 1910.23 and controlled confine space entry per OSHA standard 1910.146. The design must assure that the fall through protection is in place before the doors can be closed, thereby protecting the next operator.
- 3) Grating shall be 6061-T6 aluminum designed to withstand the same live load as specified for the hatch. Deflection shall not exceed 1/150th of the span. The grate shall also be designed to support the specific pumps provided at this pump station. This allows the pumps to be pulled from the pit, the grating closed and the pump set back on the grating for pump wash down directly back into the pit.
- 4) Safety Grates must be supplied with hinge system, hold open arms and lift assist system as the hatch covers (see reference above), and shall designed to be secured in the closed position with a padlock.
- 5) Grate openings shall be 5" x 5", which will allow for visual inspection, limited maintenance and float adjustments while the safety grate fall through protection is left in place.
- 6) Grate shall be coated with OSHA safety orange, Dupont Corlar Satin High Solids Epoxy paint, with a Dupont Corlar High Solids Epoxy Mastic Activator. Before coating of grates, grates must be shot blasted to assure a good bond with the Dupont two part epoxy.
- 7) All hatches shall be as manufactured by Syracuse Castings West, or approved equal.

p. Access Ladder & Safety Post. Unless otherwise noted on the drawings or specified, all vaults with a floor to hatch distance greater than 3.5 feet shall be provided with an OSHA approved aluminum chamber ladder with an aluminum pull-up safety post, as manufactured by Syracuse Castings West or approved equal.

- 1) Ladder bars, angles, and extrusions shall be 6061-T6 aluminum with mill finish. Rails shall be 3" x 0.130 aluminum "C" channel, and be CNC milled to accept ladder rungs. Ladder rungs shall be fully inserted into milled openings in rails, and then welded fully around 360 degrees.
- 2) Spacing of rails shall be 18" to provide a full 18" of working space on the rung, with ladder rungs spaced no more than 12" on-center. Ladder rungs shall be 1-1/4" solid round aluminum bar, fully serrated around the rung.

- 3) Stand-off brackets must be fabricated from 3/8" x 2-1/2" solid flat stock. Each mounting bracket to be supplied with (4) 7/16" holes for contractor supplied wedge anchor. Stand-off brackets shall be spaced no greater than 60" max.
- 4) Safety Post
 - a) Safety post guide tube to be constructed of 2" square aluminum tubing, milled with notches to receive the stainless steel locking pin. Pin shall be a minimum of 5/16" x 3-1/2" long.
 - b) Mounting brackets shall be Type 304 Stainless Steel and sized to fit the 2" square tubing. Safety post shall be supplied with (4) Type 304 Stainless Steel 1-1/4" I.D. U-bolts.
 - c) Safety post shall be 1-5/8" round aluminum and shall be free to slide within the guide rail, and shall lock in the up position. In the extended position, the post shall extend 42" above top of the top slab.

PART 3: EXECUTION

3.1 VAULT INSTALLATION

- a. Contractor shall excavate to depth required for construction and as approved by the Owner's Representative.
- b. Backfill material shall be stored in neat piles.
- c. Vault shall be placed on compacted sub-grade and a minimum of six (6) inches crushed rock course. Sub-grade and leveling course shall be compacted to ninety-five percent (95%) of maximum dry density per AASHTO T-180.
- d. Vault shall be placed to lines, grades and dimensions shown on plans. Vault shall be watertight.

3.2 EQUIPMENT INSTALLATION

- a. All equipment shall be installed in strict accordance with the manufacturer's recommendations and in accordance with the drawing details, manufacturer's recommendations and utility company requirements.

PART 4: SPECIAL PROVISIONS

None

SECTION 02606
CATCH BASINS AND INLETS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and constructing precast or cast-in-place inlets and catch basins of designated types and at locations shown on the drawings and schedule details.
- b. This section includes all necessary excavation, removal of existing structures, furnishing and installation of concrete, reinforcing steel, precast solid concrete block, Portland cement mortar and/or non-shrink grout, precast concrete inlet structures, flexible joints where specified, inlet castings, making watertight connections to new or existing storm sewers, and other incidental work.

1.2 DEFINITIONS

- a. The terms catch basins, inlets and area drains as used herein refer to nomenclature on standard drawings for specified structures and on details shown on the drawings.
- b. Types of catch basins, inlets, junction boxes and area drains included under this section shall be as designed and detailed on the drawings or as required by regulating authority.

1.3 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item), including but not limited to the following.
 - a) Reinforcing bar and/or reinforcing wire utilized in reinforced precast concrete products.
 - b) Lids, frames, grates, hatches, ladders, or other components made from iron or steel.
 - 2) Detailed shop drawings of frames & grates.
 - 3) Shop drawings of precast catch basin structures (if used).
 - 4) Manufacturer's literature and certification for review purposes.

PART 2: PRODUCTS

2.1 CAST-IN-PLACE CONCRETE

- a. Cast-in-place concrete shall conform to OSSC (ODOT/APWA) 00440, Commercial Grade Concrete, 3,300 psi.

2.2 PRECAST CONCRETE

- a. Unless otherwise allowed on the drawings or details, all cast-in-place or precast concrete shall be 4,000 psi at 28 days.

2.3 MORTAR AND GROUT

- a. Mortar
 - 1) Mortar used for the structures specified herein shall conform to ASTM C-270, Type S, containing no masonry cement. The mortar shall be composed of one part Portland cement to two parts sand by volume.
- b. Non-Shrink Grout
 - 1) Non-metallic non-shrink grout shall be Speed Crete Red Line, or approved equal.

2.4 CONCRETE CATCH BASINS

- a. Catch basin sizes and configuration shall be as shown or noted on the drawings and details, and as required to conform with local jurisdiction requirements.
- b. Ditch Inlet Catch Basin. Unless otherwise shown on the drawings, ditch inlet catch basins shall conform to local jurisdiction standards requirements, with 24" square concrete box and a 30° sloped welded steel grate.
- c. Catch basin castings shall conform to standard details for frame and grate as follows:
 - 1) Frame - Fabricated of structural steel, ASTM A-7, A-36 or A-273, fully welded at all joints, hot dip galvanized. Frame shall include angle frame on all sides unless otherwise shown on the drawing details.
 - 2) Grate - Fabricated of structural steel, ASTM A-7, A-36 or A-273, fully welded at all joints, hot dip galvanized.

2.5 PVC AREA DRAINS

- a. Area drains sizes and configuration shall be as shown or noted on the drawings, and as required to conform with local jurisdiction requirements.
- b. Unless otherwise shown on the drawings, area drains shall consist of the following.
 - 1) 15-inch inline drain basin with a 15" ductile iron hinged grate with cast iron frame mounted to a PVC drain basin, as manufactured by Nyloplast or approved equal.

- 2) The PVC drain basin fitting shall include an integral single piece transition from the 15-inch grate to a gasketed socket the size of the area drain riser pipe shown on the drawings.
- 3) A 22½° bend shall be installed immediately below the PVC drain basin fitting to allow the 15-inch grate to be installed at an incline. The grate hinge shall be installed on the upper edge of the area drain.

PART 3: EXECUTION

3.1 GENERAL

- a. Location and type of inlets and catch basins installed shall be as shown on the drawings, scheduled and specified herein.
- b. Standard detail drawings of the regulating authorities required catch basins and inlets shall be obtained by the Contractor.
- c. Grouting to be Smooth. All interior joints, penetrations & any exposed lifting holes shall be grouted following catch basin assembly. The grouting of all catch basins shall be smooth and uniform, and shall not retain water or debris. Any grout or concrete splatters shall be removed by the Contractor.

3.2 INSTALLATION

- a. Installation shall be in conformance with standard detail drawings.
- b. Catch basin concrete shall be free from fractures, honeycombs, surface roughness and slipped edges. Damaged precast sections will be rejected.
- c. All work shall conform to requirements of OSSC (ODOT/APWA) 00440, Commercial Grade Concrete, as to workmanship for cast-in-place concrete.
- d. Contractor shall dewater excavations prior to installation of structures.
- e. Base section shall be placed on four (4) inches of compacted granular material.
- f. Backfill shall be placed and compacted in 8-inch lifts around structures. Backfill type and compaction shall be the same as for adjacent pipe.
- g. Pipe connections shall be let into precast or monolithic concrete walls smoothly. Any broken out concrete shall be grouted back solid for minimum of six (6) inches around the entire connection using non-metallic non-shrink grout.
- h. Catch basins on public or private streets shall have two four (4)-inch diameter weepholes with granular material surrounding at subgrade level per standard drawing details.
- i. Frames and extension rings shall not be grouted in until rims can be set accurately to final grade.

- j. Unless otherwise specified or shown on the drawings, catch basin rims in paved areas shall be set one (1)-inch below grade and the pavement apron feathered thereto per standard details.
- k. Unless otherwise specified or shown on the drawings, public catch basins (ie. those located within public streets) shall be provided with sumps with a minimum depth of 12-inches. Unless otherwise approved the Owner's Representative and agency with jurisdiction (on a case-by-case basis), the sump depths for public catch basin shall not exceed 24 inches.

PART 4: SPECIAL PROVISION

None.

SECTION 02607 CONCRETE MANHOLES

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing (or modifying) concrete manholes with precast or reinforced cast-in-place bottoms as specified, including drops and manhole stacks of types and at locations shown on the drawings and scheduled.
- b. This section includes removing existing structures, additional excavation to widen and deepen trenches for manhole construction, furnishing and installing concrete, Portland cement mortar, reinforcing steel, concrete base sections, bottom riser sections, transition sections, and riser sections, eccentric cones, flat slab tops and grade rings, flexible manhole connections, pipe for drop connections, manhole steps, manhole frames and covers, plugging lifting holes, pointing joints, forming channels through manhole bottoms, making watertight connections to new and existing sewers, and other work incidental to manhole construction and testing.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item), including but not limited to the following.
 - a) Reinforcing bar and/or reinforcing wire utilized in reinforced precast concrete products.
 - b) Lids, frames, steps, ladders, or other components made from iron or steel.
 - 2) Shop drawings & manufacturer's literature and certifications for review purposes.
 - 3) Information on concrete mix design for use on precast manhole structures.
 - 4) Manufacturer's literature for all manhole appurtenances, including but not limited to boots, waterstop grouting rings (*where allowed*), mastic, joint wrap, steps, grade rings, frame & covers, drop assemblies, manhole lid inserts, etc.
 - 5) Manufacturer's literature for non-shrink grout for use in setting manhole grade rings & castings, grouting inside surfaces of all joints, pickholes, etc.
 - 6) Bidco External Joint Wrap by Telleborg, or equal (*to be installed on the external surfaces of any below grade construction joints on cast-in-place manholes, and on the external surfaces of all barrel joints and penetrations as applicable*)..

- a) Written confirmation that plastic stretch wrap (*ie. pallet wrap plastic*) will be used to cover external mastic wrap on joints and pickholes as specified (*ie. protection from displacement during backfill installation & compaction*).
- c. Regardless of submittal review comments, it is the contractor's responsibility to verify all dimensions and core locations based on actual piping layouts. If any holes not correctly located, the manhole base will need to be replaced unless the Owner Representative and agency with jurisdiction allows the hole to be plugged and re-core drilled in the correct location and alignment. Any connection holes not listed in the submittals shall be core drilled in the field as applicable.

PART 2: PRODUCTS

2.1 GENERAL

- a. Precast concrete pipe manhole bases, riser sections, transition sections, eccentric cones, flat slab tops, and adjusting rings shall conform to the requirements of ASTM C478 except as modified herein. Reinforcing in transition sections shall be equal to the requirements of that specified for wall sections of the larger diameter.
- b. Unless otherwise approved in writing on a case-by-case basis by the Owner's Representative and agency having jurisdiction, the wall thickness of barrel riser sections shall conform with minimums under ASTM C-478 as follows.
 - 1) 5" wall for 48" diameter MH
 - 2) 6" wall for 60" diameter MH
 - 3) 7" wall for 72" diameter MH
 - 4) 8" wall for 84" diameter MH
 - 5) 9" wall for 96" diameter MH
 - 6) 11" wall for 120" diameter MH
 - 7) 12" wall for 144" diameter MH
- c. All precast concrete shall be a minimum of 4000 psi at 28 days.
- d. Flat-top manholes shall be supplied for all manholes 6 feet or less in depth from rim to invert, or with any pipe connections within 5 feet of the rim elevation, or where noted on the drawings. Openings for access in flat-top manhole slabs shall be pre-formed or cored by the manufacturer.
- e. Unless otherwise specified, openings for connecting pipes in base sections or riser sections, shall be core-drilled by the manufacturer.
- f. Core-Hole Separation from Manhole Barrel Joints. The standard minimum separation between the edge of a core-hole and the nearest manhole barrel joint is 6 inches for manholes 48 to 72 inch in diameter, in order to maintain structural integrity and to prevent cracking or weakening of the manhole wall near the joint (*smaller separation for new manholes requires written certification be provided by the manhole manufacturer based on the specific proposed design for the manhole*).

For manholes greater than 72 inch diameter, the minimum separation shall increase to 8 inches.

- g. The standard height of riser sections shall be 48-inches. Heights of 12-inches through 60-inches may be used to meet required dimensions or as specified. Barrel riser section height shall be adjusted as required to maintain required separation between core-holes and barrel joints.
- h. Precast Bases Required for Sanitary Manholes. Unless otherwise specifically shown and/or noted on the drawings, **all sanitary sewer manhole bases shall be precast**, and rubber boots shall be provided at all pipe penetrations.
- i. Unless otherwise allowed on the drawings or details, all joints between manhole sections shall be O-ring or single offset mastic joints type conforming to ASTM C-443.
- j. Mastic Wrap, Sanitary Sewer Manhole Joints & Pickholes. External mastic wrap joint seal (*9-inch minimum width*) shall be installed on all manhole barrel joints after assembly and over all pickholes after grouting, prior to backfilling (Bidco External Joint Wrap BW-9T by Telleborg, or equal).
 - 1) See requirements under Section 3 for use of plastic stretch wrap (*ie. pallet wrap plastic*) to hold the mastic tape on joints in place during backfilling.
- k. Mastic Pickhole Seal, Sanitary Sewer Manholes. External mastic wrap joint seal (*9-inch minimum square*) shall be installed over all pickholes after grouting and prior to backfilling (Bidco External Joint Wrap BW-9T by Telleborg, or equal).
 - 1) See requirements under Section 3 for use of plastic stretch wrap (*ie. pallet wrap plastic*) to hold the mastic tape in place over pickholes during backfilling.

2.2 PRECAST BASES

- a. Precast base sections shall be of monolithic construction and shall be manufactured such that the base riser section is integral with the base slab for 72" diameter and smaller.
- b. Unless otherwise approved in writing on a case-by-case basis, the base slab thickness shall conform with minimums under ASTM C-478 as follows.
 - 1) 6" base for 48" diameter MH
 - 2) 8" base for 60" & 72" diameter MH
 - 3) 12" base for 84" through 144" diameter MH
- c. Openings for Pipe Connections, Connectors.
 - 1) Openings in sanitary sewer manhole bases shall be core-drilled and provided with flexible manhole-to-pipe connectors (rubber boots) for pipe connections
 - 2) Openings in storm drain manhole bases shall be either core-drilled or formed by blocking out a section of the wall during the casting process for pipe connections.
 - 3) Rubber Boots.
 - a) Flexible rubber boots for precast pipe openings (or core-drilled openings in existing manholes) shall be "Res-Seal" type by Price Brothers Company, "Kor-N-Seal" by Trelleborg, or approved equal.
 - b) Size and style of rubber boots shall be based on the size and type of pipe and the size of the opening in the manhole wall.

- 4) Grouting Ring (Sand Collar).
 - a) Where connection or reconnection to existing manholes without core-drilled openings is specifically allowed on the drawings, grouted connections to manholes shall utilize Waterstop Grouting Ring by Trelleborg, or approved equal.
 - b) Where the term “Sand Collar” is used on the drawings at sanitary sewer manhole connections, it refers to use of this waterstop specified waterstop grouting ring.

2.3 CAST-IN-PLACE BASES

- a. Cast-in place base sections are not allowed for manhole bases unless specifically approved in writing by the Owner’s Representative, or specifically shown or noted on the drawings.

2.4 MANHOLE GRADE RINGS

- a. Concrete grade rings shall have precast concrete. The distance from rim to top of cone or bottom of flattop section shall not exceed 12 inches.

2.5 MANHOLE STEPS

- a. Where specified or shown on the drawings, manhole steps shall be of polypropylene plastic reinforced with a ½-inch grade 60 reinforcing rod.
- b. Specified manhole steps shall be factory installed to provide a continuous ladder of 12-inch center-to-center rung spacing. Steps shall be placed in the forms and cast into the manhole wall or installed immediately after the pipe is removed from casting.
- c. If the outer surface of the pipe wall is pierced, the patch shall be completely covered with a mastic sealer after repair & grouting (Bidco External Joint Wrap by Telleborg, or equal).
 - 1) See requirements under Section 3 for use of plastic stretch wrap (*ie. pallet wrap plastic*) to hold the mastic tape on joints in place during backfilling.

2.6 MANHOLE FRAME AND COVER ASSEMBLIES

- a. General
 - 1) Manhole frames and covers shall be as shown on the drawings and in conformance with requirements as contained herein.
 - 2) Unless otherwise specified or shown on the details, all storm sewer manholes shall be provided with 16-hole lids, and standard sanitary manholes shall be provided with 2 hole lids.
 - 3) Where pressure tight (lock down) manhole covers are called for, lid seals shall be a continuous round rubber gasket supplied by the manufacturer, and shall be provided with a lifting lug/ring on each side instead of pickholes. Anchor bolts shall be stainless steel (provide with anti-seize).

b. Materials

- 1) Castings, unless specified otherwise, shall be gray iron castings conforming to the requirements of ASTM A-48, Class 30.
- 2) All castings shall be free from pouring faults, sponginess, cracks, blowholes, blisters, shrinkage strains and other defects affecting their strength and value for the services intended. No plugging of defective castings will be permitted.

c. Workmanship

- 1) Iron castings shall be true to pattern in form and dimensions and shall be made accurately to dimensions shown on the drawings or ordered. All castings shall be planed or ground where necessary, whether marked or not, to secure flat bearing surfaces. Allowances shall be made in the patterns so that the specified thickness of metal will not be reduced.
- 2) Lettering shall be cast on manhole covers, and covers shall be provided with bolts, locks, perforations, lifting rings and for pick holes as shown on the drawings or as specified.

2.7 NON-SHRINK GROUT

a. Standard Non-Shrink Grout

- 1) Unless antimicrobial (*H₂S resistant*) grout is specified, non-metallic non-shrink grout for grouting pick holes, barrel joints, and bedding concrete riser rings and manhole lid castings, etc. shall be Speed Crete Red Line, or approved equal.

2.8 CAST-IN-PLACE CONCRETE

- a. All cast-in-place concrete used for forming channels in manhole bottoms shall conform to OSSC (ODOT/APWA) 00440, Commercial Grade Concrete, 3,300 psi.
- b. Where Antimicrobial Admixture is specified for precast concrete manholes, the same Antimicrobial Admixture shall be added to the concrete used for manhole channeling.

2.9 REINFORCING STEEL

- a. All bar reinforcing shall be grade 60 deformed bars conforming to ASTM A-615 or ASTM-616.

2.10 CLEAN-OUTS

- a. Pipe, fittings and joints shall conform to specifications for adjacent pipe.
- b. Castings shall be as shown on standard detail.

2.11 PIPE ANCHORS

- a. Anchor bolts and anchor straps for inside drop pipe connections shall be stainless steel.

- b. Anchor bolts shall be Type 304 stainless steel and be of the sizes shown on the drawings or directed by the Owner's Representative.

2.12 INSIDE DROP ASSEMBLIES

- a. Inside drop assemblies shall be fitted with collection bowl at the top of the drop pipe. The bowl assembly shall be as manufactured by Reliner/Duran inc., or approved equal.
- b. Force main discharges and inlet pipes with slopes greater than 5% shall be fitted with a bowl with the optional hood, as well as at all locations where noted on the drawings & details, as well as any inlet pipes larger than 12-inch diameter.
- c. Drop Pipe Connection Coupling. The connection between the drop bowl and the drop pipe shall be a rubber coupler with stainless steel band clamps, MaxAdaptor Coupling (by Gripper Gasket LLC) or approved equal, consisting of an EPDM rubber gasket, high impact polyamide (nylon) securing cage & stainless steel securing clamp assembly & hardware. For pipe sizes larger than MaxAdaptors are available from the manufacturer, Fernco couplings may be used as approved by the Owner's Representative.
- d. Unless otherwise shown on the drawings, the drop pipe to be the same size as the inlet pipe. The collection bowl sizing and installation shall conform to the manufacturer's recommendations, including use of stainless steel fasteners. The drop tube shall be anchored with stainless steel pipe brackets at 4 foot maximum intervals, and provided with a 45° elbow at the base rotated to direct flow toward the manhole outlet.

PART 3: EXECUTION

3.1 GENERAL

- a. Location and type of manholes installed shall be as shown on the drawings or directed by the Owner's Representative.
- b. Construction shall be in conformance with details shown on the drawings and as specified.
- c. Pipe connections shall be let into precast concrete walls smoothly. Any broken out concrete shall be grouted back solid for a minimum of six (6) inches around the entire connection.
- d. All joints shall be carefully cleaned of sand, dirt, dust or debris prior to placing joint mastic or gasket to ensure a good seal. Excess joint mastic shall be trimmed from the interior of the manhole prior to grouting interior joints.
- e. All manhole joints and/or connections to new or existing manholes shall be watertight.
- f. **Any visible infiltration of water in sanitary sewer manholes shall be considered unacceptable and shall constitute a failed manhole test.**
- g. Inspection of Manhole Components by Contractor. All manhole components shall be carefully inspected by the Contractor when they are delivered to the site. Any manholes which have damage or voids on the surfaces where mastic or gasket seals are located are not

acceptable, shall not be field repaired, and shall be removed from the site.

- h. Grouting & Channels to be Smooth. All interior joints & penetrations shall be grouted following manhole assembly. The grouting and channels of all manholes shall be smooth and uniform, and shall not retain water or debris. Any grout or concrete splatters (*in channels, on channel benches, on walls or on steps*) shall be removed by the Contractor.

3.2 EXCAVATION

- a. Excavation for manhole construction shall be unclassified.
- b. Backfill and compaction around manholes and other appurtenances shall be as specified for the adjacent trench backfill.

3.3 MANHOLE BASE SECTIONS

- a. Excavations shall be dewatered prior to placement of base sections.
- b. Precast Base Sections.
 - 1) Aggregate base shall be placed to a minimum compacted depth of six (6) inches prior to placement of precast base section.
 - 2) The manhole base shall be fully and uniformly supported by the base rock at the specified grade and alignment and shall be set such that the top of the base section is level and plumb.
 - 3) The use of spacers between riser sections to accommodate an out-of-plumb base section is prohibited.
- c. Stubouts for Future Pipe Extensions
 - 1) Pipe stubs out of manholes for future pipe extensions shall be ended outside the manhole with a bell end with a watertight gasketed cap meeting local jurisdiction requirements. If a pipe bell is required outside the manhole, the contractor shall install a short length of plain-end pipe as required to accommodate the gasketed cap. The ears shall not be removed from screw-in plugs. Unless otherwise noted or shown on the drawings, the stubouts shall extend a minimum of 2 feet from the outside wall of the manhole and shall be installed at the specified grade.

3.4 INSTALLATION OF EXTERNAL MASTIC WRAP ON MANHOLE JOINTS & PICKHOLES

- a. Where mastic wrap on the exterior of manhole joints & pickholes is shown or noted on the drawings or required by the agency with jurisdiction (*required for all sanitary sewer manholes*), it shall be installed after joint assembly and prior to backfilling.
- b. Clean MH Exterior Prior to Mastic Wrap Installation. The exterior of the manhole barrels adjacent to each joint shall be clean (*under the mastic wrap*) to ensure a good seal. A wire brush shall be used to clean the exterior surface under the mastic wrap as required to remove all dirt, loose particles or deleterious material.
- c. Plastic Pallet Wrap for Use Over Joint Wrap Mastic.

- 1) The mastic wrap over manhole joints shall be held in place with plastic stretch wrap (*ie. pallet wrap plastic*) to hold the mastic tape in place during backfilling (*ie. to protect the external mastic wrap from displacement during backfill installation &/or compaction*). Plastic wrap shall be installed immediately after the mastic wrap is placed.
 - a) Exceptions may be approved in writing on a case-by-case by the Owner's Representative for shallow manholes (*6 feet or less to invert*), based on a full time inspector being present during manhole installation and backfill.
- 2) Deep Manholes. In all cases, pallet wrap plastic shall be used on joints of manholes deeper than 6 feet to invert.
- 3) Pickholes. In all cases, pallet wrap plastic shall be used on the mastic wrap covering the exterior of pickholes.
- 4) Cold or Wet Conditions. If conditions are cold, wet or otherwise not optimum for complete adhesion of the mastic wrap to the manhole barrel (*as determined by the Owner's Representative*), plastic stretch wrap shall be used regardless of whether or not a full time inspector is present.

3.5 MANHOLE RIM ELEVATION & PRECAST CONCRETE RISER SECTIONS

- a. The manhole rim elevations shown on the drawings may need to be adjusted upward or downward up to 6-inches from the design elevation called out on the drawings, if required to match with existing or finish grade conditions. The Contractor shall be responsible for verifying existing and future grade elevations to verify manhole depths, or be responsible for installing the manhole such that the rim elevation can be adjusted without removal and replacement of the manhole barrel sections.
- b. All manhole barrel section joints shall be grouted smooth on the interior and lifting holes filled with approved non-shrink grout.
- c. The longest lengths of riser sections to be incorporated into the manhole shall not be installed immediately below the eccentric cone section or the flat slab top.

3.6 INSTALLATION OF MANHOLE FRAMES

- a. Manhole frames and covers shall be installed to grades shown on the drawings, as specified herein or as directed by the Owner's Representative.
- b. Adjustment of manhole castings to finished grade shall be made using specified precast concrete grade rings. Frames and extension rings shall not be grouted in until rims can be set accurately to finished grade.
- c. Grade rings shall be set in mortar without offsets. The joints between grade rings shall be watertight. Grade rings shall be limited to a maximum height of twelve (12) inches.
- d. The contractor shall confirm rim elevations required to match existing or new grades, and shall notify the Owner's Representative of any discrepancies from the design elevation on the drawings. After notification of and concurrence by the Owner's Representative, the contractor shall adjust the manhole rim as required to match the existing or design grades as applicable.

- e. Lock-Down Lids. Each pressure tight (lock down) manhole casting located below the flood level shall be anchored in place using four 1/2-inch stainless steel wedge anchor bolts through the base flange of the casting, with anchor bolt length as required to provide 4" minimum embed into the flat-top slab or manhole cone, unless otherwise approved by the Owner's Representative.

3.7 MANHOLE RIM ELEVATIONS

- a. The rims of all manholes located within paved or other hard surfaced areas shall be set to finished grade.
- b. Manholes located in unpaved areas subject to vehicle or traffic loads shall be provided with a minimum 8-foot by 8-foot AC pad (3" minimum compacted thickness) or concrete pad (8" minimum thickness) centered on the manhole lid, unless otherwise approved in writing by the Owner's Representative or otherwise noted on the drawings or details.
- c. The rims of all sanitary sewer manholes located outside of paved or other hard surfaced areas (ie. all those not provided with AC or concrete pads noted above) shall be set 6-inches above surrounding grade, unless greater exposure is indicated on the drawings. Surrounding grade shall be defined as the final ground surface (after grading and landscaping), measured a maximum of 3 feet clear from the manhole frame casting (final grading immediately around the manhole to slope up to the manhole rim as noted below).
The purpose of this requirement is to prevent sanitary sewer manhole rims from becoming low points and collecting surface drainage.

Unless otherwise shown on the drawings or details, or where otherwise directed in writing by the Owner's Representative, finish grading or landscaping shall be sloped up (from surrounding grade) to within 1-inch below rim elevation for sanitary sewer manhole located outside of paved or hard surfaced areas.

3.8 MANHOLE PENETRATIONS & CHANNELS

- a. All connections to manholes (*sewer or storm*) shall be watertight and shall provide for smooth flow into and through the manholes, without ponding water.
- b. The interior of all manhole penetrations (*sewer or storm*) shall be grouted smooth.
- c. Manhole channels shall be constructed in conformance with the appropriate details. Water and debris shall be removed from precast base sections prior to placing concrete for the channels.
- d. Channels shall be constructed with troweled surfaces and smooth transitions at all changes in direction.
- e. Channels depths shall be to the heights shown on the drawings, but in no case shall be the channel depth be less than 2/3 of the pipe diameter. Flow channels in manholes shall be of such shape (semi-circular bottoms) and slope to provide smooth transition between inlet and outlet sewer size/ invert to minimize turbulence and to ensure that the manhole channels are self-cleaning. Shelves between the channels and the manhole walls shall be sloped to drain per plan details (1:12 typical).

- f. Channel bottoms and shelves shall not impound water.
- g. The channel configuration shall allow a three (3) foot long by six (6)-inch diameter television camera assembly to be placed into, or removed from the pipe without difficulty.

3.9 DROP CONNECTIONS

- a. Inside drop connection assemblies shall only be permitted where shown on the drawings or approved by the Owner's Representative. Where permitted, inside drop assemblies shall be constructed in conformance with drawings details, as specified, or as approved by the Owner's Representative.
- b. Where shown on the drawings, drop connection assemblies shall be installed on the outside of the manhole. Outside drop connections shall be constructed in conformance with the drawings details.

3.10 MANHOLES ON EXISTING STORM DRAINS

- a. Unless otherwise specifically shown on the drawings or approved in writing by the Agency with Jurisdiction, new manholes installed in existing pipelines shall have precast bases, and shall be cut into existing pipeline and reconnected to existing pipes on each side of the manhole with approved couplings as specified or as shown on the drawings.
- b. Cast-in place base sections are not allowed for sanitary sewer manhole bases unless specifically approved in writing by the Owner's Representative and the Agency with Jurisdiction.
- c. Except as modified herein, construction of manholes with cast-in-place bases over existing storm drains shall be in accordance with the requirements of the 2015 APWA Standard Specification, OSSC (ODOT/APWA) 490.41, Manholes Over Existing Sewers.
- d. Manholes Over Existing Concrete Pipes
 - 1) Prior to construction of the manhole base, existing concrete pipe shall be cleaned and an approved commercial concrete bonding agent applied to all surfaces of the pipe that will be in contact with the poured-in-place manhole base slab or grouted penetrations.
- e. Manholes Over Existing PVC Pipes
 - 1) Prior to construction of the manhole base, existing PVC pipes shall be cleaned and a dense coating of clean mortar sand mixed with PVC solvent cement applied to all pipe surfaces that will be in contact with the manhole. After the PVC solvent cement has cured, commercial concrete bonding agent shall be applied to the sand prior to placement of the poured-in-place concrete manhole base slab.
- f. All sanitary sewer manholes shall be vacuum tested in accordance with the requirements contained herein.
- g. After completion of any required manhole vacuum testing, the top of the pipe shall be broken out to the spring line for the full width of the manhole. The exposed edge of the pipe

shall be ground smooth and grouted with mortar as required to provide a smooth radius.

- h. The Contractor shall prevent broken material or debris from entering the pipeline.
- i. Flow shall be maintained at all times. The Owner's Representative's approval shall be obtained prior to diverting flows.

3.11 CONNECTION TO EXISTING MANHOLES

- a. Openings for new connections to existing manholes (*sewer or storm*) shall be made by core-drilling the existing manhole structure, unless approved in writing by the Owner's Representative and jurisdiction with authority on a case-by-case basis.

NOTE: Breaking out of a manhole wall without such written authorization (*rather than core drilling as specified*) will result in the Contractor being required to remove and replace the manhole structure with a new manhole.

- 1) Use of pneumatic jackhammers for work inside manholes shall be prohibited. Small chipping hammers or similar light tools which will not damage or crack the manhole base may be used to shape channels or enlarge existing openings as authorized by the Owner's Representative.
- b. Sanitary Sewer Manhole Connection.
 - 1) Cored Holes & Rubber Boots Required. New connections to existing sanitary sewer manholes shall be done using cored holes and a commercially prepared rubber boot specifically designed for this purpose.
 - a) Where existing openings or existing pipe interferes or conflicts with new core hole locations, the existing pipe shall be removed completely and the existing opening grouted closed prior to core drilling the new opening, in order to provide a clean hole for the rubber boot, unless approved by the Owner's Representative and jurisdiction with authority on a case-by-case basis.
 - 2) Grouted connections to sanitary sewer manholes are prohibited unless specifically called out on the drawings for a specific manhole and a specific connection.
 - a) Where grouted connections are specifically allowed and called out on the drawings, the Contractor shall make connections of the new pipe to the existing manhole with a gasketed waterstop grouting ring designed and manufactured for the specific pipe being utilized (Trelleborg Waterstop Grouting Ring or approved equal).
 - (1) NOTE: Where the term "Sand Collar" is used on the drawings for sanitary manholes, it refers to the specified waterstop grouting ring.
 - b) The pipe shall be supported outside the manhole to ensure that the waterstop grouting ring is centered in the manhole opening, and shall be

grouted into the manhole penetration (*full depth of manhole wall*) as required to provide a permanent watertight connection.

- c) Any leakage after construction or during the warranty period shall be repaired by the Contractor at no additional cost to the Owner, including but not limited to injection grouting around any leaking pipe penetrations to provide a permanent water-tight seal. Such repairs shall be made by injection of a chemical grout designed to seal sewer manholes. The chemical grout solution shall be either Acrylic or Acrylate Based Grout or Urethane Based Grout. The grout solution shall have the ability to tolerate dilution and react in moving water. After final reaction, the grout shall form a stiff, impermeable, yet flexible gel.
- 3) Sealing & Testing MH after Connections to Existing Sanitary Sewer Manholes.
Existing sanitary sewer manholes to which new pipes are connected (or where existing pipe connections are modified) shall be sealed by the Contractor as required and pass a vacuum test prior to final approval.
- c. Storm Drain Manhole Connection.
 - 1) Connections to storm manholes may use either a rubber boot or a PVC sand collar. Prior to installation of the sanded PVC collar, a commercial concrete bonding agent shall be applied to the sand prior to placement of concrete or grout.
 - 2) Openings shall be large enough to allow non-shrink grout to completely surround the sand collar and seal it in place.
- d. Manhole Rechanneling.
 - 1) Reshaping/Reconstruction of flow channels in existing manholes (sewer or storm) shall be accomplished with the use of a "clipping gun" or other similar light tool which will not damage or crack the existing manhole base.
 - 2) The channel shall be shaped to provide smooth uniform flow of water without any ponding. After modifying flow channel, thoroughly clean manhole base and apply Preco Patch as manufactured by Fosroc or approved equal non-shrink grout to provide a smooth and finished flow channel without any ponding.
- e. The Contractor shall prevent broken material and debris from entering the downstream pipeline.

3.12 LEAKAGE TESTING OF SANITARY SEWER MANHOLES

- a. All new sanitary sewer manholes (as well as all existing manholes to which new pipes are connected, or where existing pipes connected to the manholes are replaced or reconnected to existing pipe stubs outside the manhole) shall be tested in accordance with the requirements of the 2015 APWA Standard Specification, OSSC (ODOT/APWA) 00470.71.b, Vacuum Testing, except as modified herein. Manholes failing the vacuum test shall be sealed and retested.
- b. **Any visible infiltration of water in sanitary sewer manholes shall be considered unacceptable and shall constitute a failed manhole test.**

- 1) Sanitary sewer manholes that exhibit visible water infiltration or do not pass leakage testing shall be replaced or repaired by the Contractor at no additional cost to the Owner, and retested.
- c. All new storm drain manholes shall be subjected to leakage testing when such testing is required by regulating authorities having jurisdiction or when such testing is determined to be necessary by the Owner's Representative.
- d. Test after Surface Restoration and/or Paving. All adjacent surface restoration shall be completed prior to conducting manhole acceptance tests, including finish paving and final adjustments to grade. Any test conducted prior to completion of surface restoration shall be considered informal, and will not count for acceptance.
- e. The Contractor shall conduct leakage testing using the following method(s) as directed by the Owner's Representative:
 - 1) Vacuum Testing
 - a) Vacuum testing shall be used for all manholes requiring testing unless otherwise approved in writing by the Owner's Representative.
 - b) The Contractor shall furnish the vacuum pump, connections, plugs, vacuum gauges and other necessary equipment and perform vacuum tests on all new manholes unless otherwise directed in writing by the Owner's Representative.
 - c) Test Vacuum Gauges. All vacuum gauges used for pressure measurement shall be in excellent condition, and shall be provided with graduations not greater than 1" mercury. Any evidence of gauge damage or stickiness (ie. gauge will not zero, needle creeping upwards during test, needle moves to higher or lower reading when gauge is tapped, etc.) will result in the test being aborted until the gauge is replaced.
 - d) The test shall consist of plugging all inlets and outlets and placing the vacuum test head in the casting at the top of the cone or flattop section. The test head seal shall be inflated in accordance with the manufacturer's recommendations, but in all cases the grade rings and casting shall be included in the test.
 - e) A vacuum of 10-inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9-inches.
 - f) The manhole shall pass if the time for the vacuum reading to drop to 9-inches meets or exceeds the values indicated on the following table.

REQUIRED MANHOLE VACUUM TEST TIMES			
Manhole Depth (feet)	Required Test Time (sec) (OSSC/ODOT/APWA 00470.71.b)		
	48-inch diameter	60-inch diameter	72-inch diameter
8 or less	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	60	78	97

PART 4: SPECIAL PROVISIONS

4.1 TEST REPORT FORM(S)

- a. See following page(s):

MANHOLE VACUUM TEST REPORT

Project Location: (City)					Project Name:		
Inspector: (Print)					Date: (Separate Report Required for Each Test Session)		
Testing Company: (Name & Phone #)							
Manhole No.	Manhole Diameter (inch)	Manhole Depth (ft)	Surface Restoration Complete?	Time Required ³ (sec)	Time to Drop from 10" Hg to 9" Hg (sec)	Results	Comments (Visible groundwater infiltration or leakage constitutes a failed test)
			Yes / No			Pass / Fail	
			Yes / No			Pass / Fail	
			Yes / No			Pass / Fail	
			Yes / No			Pass / Fail	
			Yes / No			Pass / Fail	
			Yes / No			Pass / Fail	
			Yes / No			Pass / Fail	
			Yes / No			Pass / Fail	

1. All adjacent surface restoration shall be completed prior to conducting manhole acceptance tests, including finish paving and final adjustments to grade. Any test conducted prior to completion of surface restoration shall be considered informal, and will not count for acceptance.
2. The vacuum test head seal shall be inflated in accordance with the manufacturer's recommendations, but in all cases the grade rings and casting shall be included in the test. A vacuum of 10-inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9-inches.
3. The manhole shall pass if the time for the vacuum reading to drop to 9-inches meets or exceeds the values indicated on the following table. Times for deeper depths as required by the City Engineer. Note: Visible groundwater infiltration or leakage constitutes a failed test.

REQUIRED MANHOLE VACUUM TEST TIMES			
Manhole Depth (feet)	Required Test Time (OSSC/ODOT/APWA 00470.71.b) (sec)		
	48-inch diameter	60-inch diameter	72-inch diameter
8 or less	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	60	78	97

SECTION 02634
CARRIER PIPE AND BORED CASING

PART 1: GENERAL

1.1 SCOPE

- a. This specification includes the trenchless installation of casing pipe using the horizontal boring trenchless construction method.
- b. Work shall include, but is not limited to, the following:
 - 1) Obtain all necessary permits, bonds and insurance required by the City, County and/or other regulating authorities.
 - 2) Furnish and install casing for bored crossing as shown on the drawings.
 - 3) Installation of carrier pipe and appurtenances in casing.
 - 4) Coordinate with other regulating authorities.
 - 5) Furnish any and all protective fencing, berms and/or guard rails as required by the regulating authority.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals shall conform to the requirements of these Contract Documents and shall include:
 - 1) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item).
 - 2) Copies of applicable permits, including proof of insurance.
 - 3) A bore plan consisting of the following information at a minimum.
 - a) The size and type of equipment to be used to complete the crossing.
 - b) Equipment layout plan drawing.
 - c) Information about the Line and grade monitoring system.
 - d) Spoils management plan.
 - e) A contingency plan for excavation dewatering and effluent handling and disposal.
 - 4) A contingency plan in the event that squeezing or running soils are encountered along the tunnel zone.
 - 5) A contingency plan to mitigate difficulties maintaining line and grade during construction.

- 6) A contingency plan in the event that obstructions impede the forward progress of the bore.
- 7) Engineered shoring plans for the launching and receiving pits that are stamped by a professional engineer licensed in the State of Oregon.
- 8) Manufacturer's information on bore casing pipe.
- 9) Manufacturer's information/literature on casing spacers, including sketches showing proposed layout of casing spacers to meet specification requirements.
- 10) Manufacturer's information/literature on clamp-on end seals (*only for installations without sand fill, since masonry/grout end caps with sand feed & vent tubes are required where sand filling is required*).
- 11) As-built location, elevation & slope of the casing (*following installation*).

PART 2: PRODUCTS

2.1 EXCAVATION AND BACKFILL

- a. Conform to requirements of applicable sections contained herein.
- b. Backfill with same material as that used for carrier pipe.

2.2 CASING PIPE

- a. Contractor shall be responsible for selecting a jacking pipe thickness based on geotechnical conditions, anticipated jacking forces, the means and methods of construction, and the requirements of the permitting agencies (if applicable).
- b. Jacking pipe shall be steel pipe conforming to ASTM 139, Grade B or greater as determined by Contractor's jacking force calculations with a minimum factor of safety of 1.5.
- c. Jacking pipe shall have a minimum wall thickness of 0.500 inch or greater, as determined by Contractor's jacking force calculations with a factor of safety of 1.5, unless otherwise agreed upon by City. Any buckling of the jacking pipe due to jacking forces shall be the sole responsibility of the Contractor
- d. Jacking pipe shall have a difference in roundness between the major and minor outside diameters not exceeding 1% of the specified nominal outside diameter, or ¼ inch, whichever is less.
- e. The class of casing specified is based upon the superimposed loads and not upon the stresses resulting from jacking or boring operations. Any increase in casing strength to withstand jacking or boring operations shall be the responsibility of the Contractor, supplied at no additional cost to the Owner.

2.3 CARRIER PIPE

- a. Carrier pipe (ie. the pipe which carries water or other product through the casing pipe) shall conform to specifications requirements, or as shown or noted on the drawings.

- b. Unless otherwise noted on the drawings, pressurized carrier pipe shall be provided with restrained joints through the casing pipe (field-lok style gaskets for DI pipe, or approved equal).

2.4 CASING SPACERS (SKIDS)

- a. Style CCS Cascade waterworks mfg. co. centered and restrained dielectric casing insulators or approved equivalent shall be installed in accordance with manufacturers installation instructions and placement guidelines.
- b. All spacers used for grade critical gravity sewer and storm lines shall have field adjustable or field trimmable runners to allow for grade and elevation adjustment.
- c. The number of casing spacers per length of pipe shall not be less than three (3), or more as required to provide a maximum spacing of 6-foot on center between casing spacers.

2.5 END SEALS

- a. Casing Pipe with Sand Filled Annular Space. Where casings are filled with sand (gravity or non-pressure pipelines), end seals shall be grout/masonry end caps with 4" minimum diameter sand feed and vent tubes at each end. The vent tubes shall be plugged with grout after the casing is filled with sand.
- b. Casing Pipe without Sand Filling. Where casings are not filled with sand (pressure pipelines), end seals shall be Model AC (pull-on) or Model AW (wrap-around with pressure sensitive butyl mastic strips) end seals as manufactured by APS, or approved equal, fastened to the casing and carrier pipe with stainless steel bands.

PART 3: EXECUTION

3.1 GENERAL

- a. Construction in all cases shall conform to the requirements of regulating authority. A minimum of seven (7) days notice to the regulating authority is required prior to entry of right-of-way for construction of bored crossing.
- b. Before the start of work, Contractor shall submit satisfactory evidence to the Owner's Representative that he has complied with all permit and insurance requirements.
- c. Temporary fencing and warning barricades shall be installed around the boring pit(s) in accordance with all Federal, State, local and regulating authority requirements.

3.2 EXCAVATION

- a. Excavate the launching and receiving pits to the lines and grades shown on the engineering design drawings and/or in a manner to allow proper placement of the horizontal boring equipment, thrust block and guidance system and utilize methods which include due regard for safety of workers, adjacent structures, utilities and the public. If necessary, a concrete pad, crushed rock or other surfacing shall be provided for horizontal and vertical alignment of the horizontal boring machine guide rails.

- b. Install engineered shoring within the excavations prior to allowing personnel or equipment to enter/be placed in the launching or receiving pit.
- c. Furnish and operate a temporary ventilation system and air monitoring system conforming to the requirements of OR-OSHA, if necessary. Operate and maintain a ventilation system that provides a sufficient supply of fresh air and maintains an atmosphere free of toxic or flammable gases in the jacking pit.

3.3 INSTALLATION OF CASING PIPE

- a. Conduct horizontal boring operations checking for alignment and grade at least once a day or every 40 feet, whichever is more frequent. Jack each pipe section forward as the excavation progresses in such a way to provide complete and adequate ground support at all times.
- b. Limit overcut to less than ½ inch radially. The radial overcut shall be determined as the difference between the maximum diameter created by the cutting head or overcut band and the outer diameter of the pipeline or casing, divided by two.
- c. Provide a lubrication system as needed to reduce skin friction and prevent pipe binding or stoppage, if necessary. Pipe lubricants shall be injected continuously as the pipe is advanced, in sufficient volume to, at a minimum, completely fill the calculated annular volume produced by the overcut.
- d. Line and grade tolerances shall be limited as follows:
 - 1) Horizontal alignment: Plus or minus 2 percent of the bored length from design alignment shown on the drawings.
 - 2) Vertical alignment: Plus or minus 1 percent of the bored length from design profile shown on the drawings.
- e. In the event the bore is off line or grade, return to the plan line and/or grade at a rate of not more than one (1) inch per 25 feet of jacking pipe advancement. CONTRACTOR shall remove horizontal flights and check line and grade measurements with the use of a laser every day or every 40 feet, whichever is more frequent. Laser support shall be independent of working slab, jacking frame, and thrust block to avoid movement of the laser during jacking. Line and grade shall be maintained to within the tolerances provided herein.
- f. Do not exceed the allowable jacking force as given by the pipe manufacturer or in accordance with Contractor calculations (including factor of safety).
- g. The horizontal boring equipment and operation shall be conducted in a manner to control over-excavation, surface settlements and heave above the pipeline to prevent damage to existing utilities, facilities, and improvements. Ground movements shall be limited to values specified by permit for features being crossed and that do not cause damage or distress to surface features, utilities or improvements. Contractor shall be responsible for any damage and make repairs as necessary and to the satisfaction of City, at no additional cost to City, and without schedule extension. The maximum allowable settlement or heave is 0.25 inches vertical from identified survey hub control points, or in accordance with permit conditions.

- h. Continuously monitor the alignment for indications of casing lubricant or grout release, if used. If a release occurs, installation should be temporarily suspended while the release is contained and cleaned.
- i. After completing the work, Contractor shall provide City or their representatives access to both pipe ends for visual inspection of the line, grade and condition of the completed pipe installation.

3.4 PIPE INSTALLATION IN CASING

- a. Casing spacers shall be placed on the carrier pipe as shown on the drawings or specified herein so that pipe is supported continuously by the skids and is not supported by the bells.
- b. Carrier pipe and casing spacers shall be gently pulled through casing to avoid damage to pipes and couplings.
- c. Contractor shall provide a means of pulling the toning wire through the casing when the use of non-metallic carrier pipe is specified. All splices in toning/tracer wire shall be completed with watertight and corrosion resistance splices (waterproof wire nuts).
- d. PVC or HDPE Pipe. In order to prevent over-belling of PVC or HDPE pipe while installing it through the casing, the Contractor shall provide a method for restricting the movement between the assembled bell and spigot in accordance with the recommendations of the pipe manufacturer (to prevent over-insertion of the spigot end into the bell end). Unless otherwise approved in writing by the Owner's Representative, this shall be accomplished by installing a casing spacer at the pipe stop line on the spigot side of each pipe joint (see also standard bore casing details).
- e. Sand Filling for Gravity Pipelines.
 - 1) For gravity sewer or storm drain carrier pipes, the casing annular space shall be completely filled with sand to prevent floatation of carrier pipe by groundwater, regardless of the type of carrier pipe used.
 - 2) Water Filled Carrier Pipe. For gravity pipelines, the carrier pipe shall be completely filled with water prior to installing or blowing sand. Contractor shall provide all plugs and/or fittings as required to accomplish this.
 - 3) The Contractor shall be responsible to demonstrate to the Owner's Representative that the annular space between the casing and carrier pipe is completely filled with sand, prior to backfilling the end of the casing pipe.

3.5 CLOSURE OF CASING AFTER CARRIER PIPE INSTALLATION

- a. Both ends of the casing shall be sealed with end seals as specified or shown on the drawings. Manufactured end seals shall be fastened in place with stainless steel bands provided by the end seal manufacturer.

- b. The bore casing shall not be backfilled prior to inspection of the end seals by the Owner's Representative and agencies with jurisdiction. Backfilling prior to inspection will require excavation for inspection at no additional cost to the Owner.

3.6 RESTORATION OF TRENCH LINES

- a. Where pipe must be laid across the bore pit, the pit shall be filled with compacted granular material to the pipe spring line.
- b. Trench backfill and surface restoration shall conform to the specification contained herein.

PART 4: SPECIAL PROVISIONS

None.

**SECTION 02936
SEEDING AND MULCHING**

PART 1: GENERAL

1.1 SCOPE

- a. This section includes fine grading, furnishing and placing topsoil, seed fertilizer and mulching material to areas designated on the drawings, specified, or ordered by the City, and watering until growth is assured.
- b. The Contractor shall seed and mulch all disturbed areas or areas damaged by his operations.
- c. Unless otherwise specified herein or directed, work shall be in conformance with OSSC (ODOT/APWA) 01000, Seeding.
- d. Slope protection matting shall be placed over seeding on all slopes steeper than 3H:1V in accordance with OSSC (ODOT/APWA) 00280, Erosion & Sediment Control.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
 - 1) Manufacturer's material certification.
 - 2) To Owner:
 - a) Invoices showing the weight, brand and composite analysis of all fertilizer used on the project.
 - b) Bag tickets showing weight and composition of all seed used on the project.

1.3 PROTECTION

- a. Seed shall be sown only between the dates of February 1 and May 15, or August 1 and October 30, unless otherwise permitted by the Owner's Representative.
- b. The operation of finish grading and sowing shall not be performed when the ground is frozen or muddy.
- c. Permanent seeding on all embankments and disturbed areas shall be established as soon as construction is completed.

PART 2: PRODUCTS

2.1 SEED

- a. Dwarf grass seed mixture (low height, low maintenance) shall consist of dwarf perennial ryegrass (80% by weight) and creeping red fescue (20% by weight). Application rates shall be a minimum of 100 lbs per acre.

2.2 FERTILIZER

- a. Grass seed shall be fertilized with slow release fertilizer in accordance with manufacturer's recommendations.

2.3 MULCHING MATERIAL

- a. When used, hydromulch shall be applied with grass seed at a rate of 2000 lbs. per acre between April 30 and June 10 or between September 1 and October 1, unless otherwise specified on the drawings or by erosion control permits. On slopes steeper than 10 percent, hydroseed and mulch shall be applied with a bonding agent (tackifier). Application rate and methodology to be in accordance with seed supplier recommendations.
- b. Mulch used in landscape or lawn areas shall be either hydromulch or finely chopped fescue or rygrass straw mulch conforming with OSSC (ODOT/APWA) Section 010300.15.
- c. When use is allowed by jurisdiction in lieu of hydromulch (in areas other than landscape or lawn areas), dry, loose, weed free fescue or rygrass straw used as mulch shall be applied at a rate of 4000 lbs. per acre (double the hydromulch application requirement). Anchor straw by working in by hand or with equipment (rollers, cleat trackers, etc.). Mulch shall be spread uniformly immediately following seeding.

2.4 TOPSOIL

- a. Material consisting of loose, friable, loamy topsoil without admixture of subsoil or refuse. It shall be reasonably free from peat, muck, roots, hard clay, coarse gravel, stones, weeds, tall grass, brush, sticks or other litter. For topsoil to be considered loamy, the fraction passing No. 10 sieve shall contain not more than 40% clay. Topsoil shall contain not less than 5% nor more than 20% organic matter as determined by loss on ignition of oven dried samples to constant weight at 212°F.

2.5 SLOPE PROTECTION MATTING

- a. Slope protection matting shall conform with OSSC (ODOT/APWA) 00280, Erosion & Sediment Control.
- b. For slopes steeper than 3H:1V but less than 2H:1V (or where slope protection matting is indicated on the drawings), the erosion matting shall be a type that has a extended term functional longevity (ie. minimum 12 months degradability) and specifically designed for use on slopes 3:1 to 2:1 to ensure that the steep slopes are protected until they have adequate vegetation cover established before the matting biodegrades away.
 - Slope protection matting shall be S150 matting by Tensar/North American Green, or approved equal.

- c. For slopes 2H:1V or steeper (or where slope protection matting is indicated on the drawings), the erosion matting shall be a type that has a extended term functional longevity (ie. minimum 24 months degradability) and specifically designed for use of 2:1 or steeper slopes to ensure that the steep slopes are protected until they have adequate vegetation cover established before the matting biodegrades away.
 - Slope protection matting shall be SC150 matting by Tensar/North American Green, or approved equal.

PART 3: EXECUTION

3.1 PREPARATION OF AREAS TO BE SEEDED

- a. Those areas to be seeded shall be at established grades, cross sections, and finish specified at the time of seeding.
- b. All areas to be seeded shall be made substantially clear and free of weeds, briars, sticks, loose stones greater than 1-inch, and all other debris detrimental or toxic to the growth of grass.
- c. The surface soil on all areas to be seeded shall be in a condition favorable for the germination and growth of grass seed. When conditions are not favorable to germination and establishment of the grass seed, the Contractor shall irrigate the seeded and mulched areas as required to establish the grass cover. The Contractor shall coordinate with the City for any required temporary water service, and pay all fees associated with such water service.
- d. A minimum of ½-inch and maximum 1½ inches of surface soil shall be in a loose condition. Soil preparation operations shall be directional along the contours of the areas involved. On cut and fill slopes, the operation shall parallel the roadbed center line to form minor ridges to retard erosion and retain the grass seed.
- e. All areas to be seeded shall be prepared in accordance with OSSC (ODOT/APWA) 01000, Seeding.

3.2 SEEDING

- a. The mixture to be applied through a pressure-spray distribution system providing a continuous, non-fluctuating discharge. The application of the materials shall be by using a sweeping, horizontal motion of the distributing device.

3.3 SLOPE PROTECTION MATTING

- a. Install slope protection matting on all slopes steeper than 5H:1V as specified herein, and in accordance with OSSC (ODOT/APWA) 00280, Erosion & Sediment Control.

3.4 WATERING AND MAINTENANCE

- a. Seeded areas shall be watered and maintained as specified below until they are established.

- 1) The seed bed shall be thoroughly watered, as soon as the seed is covered, at the rate of 120 gal/1,000 sf.
- 2) Water shall be applied by a hydroseeder or water tank under pressure with a nozzle producing a spray that will not dislodge the mulching material.
- 3) The Contractor shall irrigate the seeded and mulched areas as required to establish the grass cover. Water applications shall be made at least once a week, provided significant rainfall has not occurred within the weekly period. The rate of application shall be 120 gal/1,000 sf.
- 4) Maintenance shall consist of the repair of areas damaged by erosion, wind, fire, inadequate watering or other causes. The soil in these damaged seeded areas shall be restored to the condition and grade existing prior to application of matting, and restored areas shall be re-limed, re-fertilized, and reseeded.

3.5 NOTIFICATION

- a. The Contractor shall give at least two days notice to the Owner's Representative of the time and place of starting his operations and shall keep the Owner's Representative advised of his schedule of operations. Favorable weather conditions shall be selected by the Contractor and approved by the Owner's Representative.

PART 4: SPECIAL PROVISIONS

None.

DIVISION 3

CONCRETE

SECTION 03100
CONCRETE FORM WORK

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing all form work for cast-in-place concrete as required for completion of the work.

1.2 STANDARDS

- a. All form work for cast-in-place concrete shall conform to the recommendations of ACI PRC- 347, Guide to Formwork for Concrete, except as modified herein.

1.3 FORM WORK DESIGN

- a. Responsibility: It shall be the Contractor's responsibility to design, furnish, install and remove all form work and perform incidental work as required to produce concrete structures in conformance with the drawings.
- b. Design: Form work shall be designed to support all anticipated loads without movement or bending and to produce concrete structures conforming to the dimensions and contours shown on the drawings.

1.4 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) Form material proposed for use against the concrete surface.
 - 2) Form tie system proposed for use.
 - 3) For Water-Tight or Water Holding Structures.
 - a) Mechanical plugs designed for use at center of taper tie holes.
 - b) Taper tie void brush specifically designed for cleaning taper tie holes proposed.
 - c) Non-shrink water-insensitive grout for use in filling taper tie holes on both sides of the mechanical plug.

PART 2: PRODUCTS

2.1 FORM MATERIALS

- a. Form material for surfaces exposed to view in finished work shall be new plywood, hard plastic finished plywood, or steel in suitable condition to produce good quality and acceptable concrete surfaces.

- b. Forms for surfaces that will be covered with backfill may be of steel, plywood, or dressed matched lumber.
- c. Used plywood will be permitted only if conditions are acceptable to the Owner's Representative or forms are lined with commercial hardboard or plastic liners.
- d. Form material for surfaces not exposed to view in the finished work may be dressed new tongue-and-groove or shiplap boards, free from loose knots or other defects, plywood in acceptable condition, or steel.

2.2 CORNER CHAMFERS

- a. Unless otherwise specifically noted on the drawings or directed in writing otherwise by the Owner's Representative, above grade portions of concrete members and concrete slabs shall be provided with 3/4-inch chamfers on all exposed corners.

2.3 FORM TIES

- a. All form ties shall provide adequate and positive spacing of forms before and during placing and processing of concrete.
- b. Form ties for all walls exposed to weather, earth or water shall have conical type plastic or rubber inserts and shall be so constructed that when forms ties and inserts are removed, no metal is within 1 inch of any surface.
- c. Plastic or rubber inserts or heads shall be of sufficient dimensions to permit proper grouting of the tie hole after insert removal.
- d. The Owner's Representative may direct the use of a specific type of insert or head where appearance is important and this type shall be used where directed.
- e. Tie wires shall not be used for holding forms.
- f. Water Retaining or Water-Tight Structures

1) Removable Taper Ties.

- a) Unless otherwise specified or specifically shown on the drawings, or approved the Owner's Representative, all form ties for water retaining structures shall be removable taper ties, with the larger end of the taper being on the wet side of the wall.
- b) A preformed mechanical tightened plug specifically designed for use in plugging taper tie holes (*Sika Greenstreak X-Plug, or P-120 X-Plug by Elite Products, or approved equal*) shall be provided, consisting of an EPDM rubber grommet body with stainless steel fender washers on each end, designed to be expanded in place by a fluoropolymer coated stainless steel bolt/nut through the center of the plug. The plug shall be designed to allow tightening from one side only (*ie. without the need to hole by bolt head in order to tighten & expand the plug*). The plugs shall

be sized to match the taper tie holes, and allow for insertion near the center of the wall, prior to the taper tie hole on both sides of the mechanical plug being filled with an approved grout product.

- c) Taper tie plug systems shall be provided with a taper tie hole/void brush specifically designed to thoroughly clean the taper tie holes of dust, debris, excess grease, etc., prior to installation of the mechanical plug and packing with non-shrink grout.
- d) A non-shrink water-insensitive grout (*acceptable to the Owner's Representative*) shall be used to fill taper tie holes on both sides, after installation of the specified mechanical plugs.

PART 3: EXECUTION

3.1 GENERAL

- a. Set on Granular Baserock. Unless greater thickness is required or otherwise specifically noted on the drawings, all concrete forms shall be placed on a minimum of 4-inches of compacted granular baserock (*3/4"-0 granular baserock unless otherwise specified*).
- b. Forms shall be mortar tight and shall be properly braced or tied together so as to maintain desired position and shape until removed.
- c. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework and shoring shall comply with applicable Local, State and Federal regulations.
- d. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Owner's Representative and shall be in sufficient number and properly installed. During concrete placement the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.
- e. Openings shall be provided in forms as required so that concrete is dropped no farther than 5 feet in walls 8 inches or less in width, and no more than 8 feet in walls wider than 8 inches.
- f. Temporary openings shall be provided at the base of wall forms and at other points where necessary to facilitate cleaning and inspection immediately before depositing concrete.
- g. Construct forms to shape, lines, grades, and dimensions of concrete called for on plans.
- h. All walls shall be plumb with level tops; all floors shall be either level or sloped toward a floor drain where provided or as specified.

3.2 CORNER CHAMFERS & BEVEL STRIPS

- a. Unless otherwise specifically noted on the drawings or directed in writing otherwise by the Owner's Representative, above grade portions of concrete members and concrete slabs shall be provided with 3/4-inch chamfers on all exposed corners.

- b. Failure to install corner chamfer strips during form placement will result in the exposed concrete corners being ground to form the required chamfer, unless otherwise approved in writing by the Owner's Representative.
- c. Unless otherwise specifically noted on the drawings or directed in writing otherwise by the Owner's Representative, bevel strips shall be placed in the forms to provide a V-notch at all exposed horizontal joints between a wall and slab.

3.3 FORM TOLERANCES

- a. Forms shall be constructed and maintained to required dimensions and to insure satisfactory fit of all components of structure.
- b. The variation from established lines and grades shall not exceed ¼-inch in ten (10) feet and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the "Suggested Tolerances" specified in Section 3.3 and 3.4 of ACI PCR-347.

3.4 REUSE OF FORMS

- a. Forms for repeated use shall be supplied in numbers to provide for the required rate of progress. Damaged forms shall not be reused.
- b. All nails shall be removed and all surfaces in contact with concrete shall be cleaned before reusing form materials.
- c. Reuse of forms and form lumber will be permitted only when condition of forms or form lumber is approved by the Owner's Representative.
- d. It is the intent of this specification to maintain "NEW FORM" appearance for all work.

3.5 FORM TIES

- a. Removable Ties:
 - 1) Where taper ties are used, the larger end of the taper tie shall be on the wet side of walls in water retaining structures.
 - 2) After the taper tie is removed, the hole shall be thoroughly cleaned with a taper tie brush to ensure an adequate seating of the mechanical plug and bond with the grout.
 - 3) A mechanical taper tie void plug as specified shall be inserted near the center of the wall, and tightened in place.
 - 4) After the plug has been inserted, the hole shall be completely filled with non-shrink water-insensitive grout for water bearing and below-grade walls and for above-grade walls which are dry on both sides.
 - 5) Exposed faces of above grade walls shall have the outer 1-inch of the tie hole filled with a grout which matches the color and texture of the surrounding wall surface.

- b. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste.

3.6 OILING

- a. Unless otherwise directed, contact surfaces of forms shall be coated with colorless non-staining mineral oil free from kerosene, or other approved herein suitable material, to permit satisfactory removal of forms.
- b. Where oil or similar material is used, it shall be applied prior to form installation if possible and before reinforcement is placed.
- c. In no case shall form oil be allowed to coat reinforcing steel.

3.7 SUPPORT OF REBAR, EMBEDMENTS AND/OR KEYWAY BLOCKOUT FORMS

- a. Driving form stakes or rebar into the ground for support of rebar, embedments or keyway blockout forms will not be allowed for any slab cast on grade, unless specifically approved in writing by the Owner's Representative on a case-by-case basis.
- b. Use of support stakes through the slab are expressly prohibited for concrete which is required to retain water, or where there will be groundwater above the slab level after concrete placement.
 - 1) Support for Embedments, etc. For slabs which are required to retain water, or where there will be groundwater above the slab level after concrete placement, all rebar, embedments and/or keyway blockout forms shall be supported from falsework or temporary supports suspended above the slab, unless they can be supported by dobies or chairs specifically designed for water-tight embedment in concrete.
- c. Any groundwater leaks in slabs (*during construction or during the warranty period*) resulting from use of form stakes through a concrete slab for support shall be drilled out to provide a clean hole diameter and plugged with a preformed mechanical tightened plug specifically designed for use in plugging holes through concrete watertight (*Sika Greenstreak X-Plug, or approved equal*), with the plug set at or near the center of the slab thickness, at no additional cost to the Owner. A non-shrink water-insensitive grout (*acceptable to the Owner's Representative*) shall be used to fill the hole after installation of the specified mechanical plug.

3.8 FORMS FOR SIDEWALKS

- a. Concrete forms for sidewalks and driveways to be standard steel forms or wood forms constructed of 2-inch lumber.
- b. Curved forms to be constructed of plywood bent to exact radius and securely fastened to prevent movements.
- c. Set forms to true lines and grades and securely stake in position.
- d. Provide additional bracing as required to prevent spreading.

3.9 FORMS FOR CIRCULAR STRUCTURES

- a. Forms for circular structures shall conform to the circular shape of the structure. Straight panels may be substituted for circular forms if they do not exceed two (2) feet in width nor deflect more than $3\frac{1}{2}^{\circ}$ per joint and do not conflict otherwise with these specifications and/or drawings. These forms shall also comply with all form requirements outlined above.

3.10 FORM INSPECTION & APPROVAL REQUIRED PRIOR TO CONCRETE PLACEMENT

- a. Unless otherwise authorized in writing by the Owner's Representative, the contractor shall not place the second side of wall forms until after the construction joint, water stop and reinforcing steel inspections have been completed and approved by the Owner's Representative.
 - 1) The contractor shall, at no additional cost to the Owner, remove one side of the wall forms which are placed prior to approval of reinforcing steel, when directed by the Owner's Representative.
- b. After the second side of all wall forms are in place, and prior to placement of concrete, all form work shall be inspected and approved by the Owner's Representative.
- c. Contractor shall notify the Owner's Representative a minimum of forty-eight (48) hours (*ie. two business days*) prior to inspections being needed.

3.11 REMOVAL OF FORMS

- a. Form removal shall not begin until concrete has attained the necessary strength to support its own weight and construction live loads, and has sufficient strength to prevent cracking or chipping when forms are removed.
- b. Careful procedures for the removal of forms shall be strictly followed and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. Contractor shall be responsible for all damage resulting from premature removal of forms.
- c. Wall and Column Form Removal
 - 1) Forms for all vertical walls and columns shall remain in place for a minimum of 48 hours after the concrete has been placed, except for periods of cold weather (*where temperature falls below 40°F*), in which case forms shall remain in place for a minimum of 72 hours after concrete has been placed.
 - 2) The timing prior to installation of compacted backfill against and adjacent to walls and columns shall conform with the requirements under Section 03300.
- d. Suspended Slab Form Removal
 - 1) Forms for all suspended slabs and suspended beams shall remain in place until all of the following are satisfied.
 - a) Concrete has been in place for a minimum of seven (7) days.

- b) Test cylinders attain a minimum compressive strength of seventy-five percent (75%) of the 28-day strength specified.
- 2) For suspended slabs installed in segments, no forms shall be disturbed or removed from under an individual panel or unit until the concrete in the adjacent panel or unit has attained seventy-five percent (75%) of the specified 28-day strength AND has been in place for a minimum of seven (7) days.

PART 4: SPECIAL PROVISIONS

None.

SECTION 03151 WATERSTOPS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing all waterstops where required to prevent leakage through construction and expansion joints.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals for Review: Submittals & shop drawings including complete specifications, descriptive drawings, and literature for all materials proposed for use, including but not limited to the following.
 - 1) Each size and type of waterstop to be used.
 - 2) Installation and splicing instructions from the manufacturer.
 - 3) A test report shall accompany each lot of waterstops shipped to the site, including the manufacturers certification that the waterstop material meets the physical requirements as outlined herein.

1.3 GUARANTEE

- a. The Contractor shall provide a three (3) year written guarantee of the entire joint sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the Owner, at no additional cost to the Owner, any such defective areas which become evident within said three (3) year guarantee period.

PART 2: PRODUCTS

2.1 GENERAL

- a. Waterstops for expansion joints and construction joints shall be of virgin PVC compound corresponding to U.S. Army Corps of Owner's Representatives' Specifications CRD-C572. Material shall have a tensile strength of 2,000 psi and shall not contain any scrap, reclaimed material or pigment.
- b. All water stops shall have parallel ribs or protrusions on each side of the center of the strip.
- c. Unless otherwise shown on the drawings, all waterstops shall conform to the following.
 - 1) Waterstops for construction joints shall be ribbed type, six (6) inch wide continuous flexible membrane with 5/8-inch O.D. hollow center bulb and not less than 3/8-inch thick adjacent to the center bulb and 1/4-inch thick at the outer edges. All waterstops for construction joints shall be Type 5 Horn/Durajoint PVC waterstop or

approved equal.

- 2) Waterstops for expansion joints shall be ribbed type, nine inch (9") wide continuous flexible membrane with 5/8-inch O.D. hollow center bulb and not less than 3/8-inch thick adjacent to the center bulb and 1/4-inch thick at the outer edges. All waterstops for expansion joints shall be Type 7 Horn/Durajoint PVC waterstop or approved equal.

- d. Unless otherwise approved by Owner's Representative, prefabricated joint fittings shall be used at all intersections of ribbed-type waterstops.

PART 3: EXECUTION

3.1 GENERAL

- a. Waterstops are required at all formed joints in concrete walls and slabs which separate habitable spaces, machinery and equipment areas from groundwater or from water filled tanks, basins, flumes, manholes, etc. Waterstops shall also be placed in vertical joints in tank walls and in other joints as shown on the drawings.
- b. Unless otherwise shown or specified, all waterstops shall be fully continuous for the extent of the joint. Water stops shall be joined by splicing at all intersections so that continuous seal is provided against passage of water.
- c. Suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.
- d. The Contractor shall take suitable precautions to support and protect the waterstops during the progress of the work and shall repair or replace any waterstops damaged during the progress of the work at no additional cost to the Owner.

3.2 WATERSTOP INSTALLATION

- a. Waterstops shall be installed as specified herein and in accordance with manufacturers recommendations.
- b. Adequate provisions shall be made to support the waterstops during the progress of the work and to ensure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be ensured by thoroughly working it in the vicinity of all joints.
- c. In cases where pre-formed expansion joint material is used in conjunction with a water stop, allowance shall be made for equal water stop embedment on each side in concrete.
- d. Splicing
 - 1) Unless otherwise approved by the Owner's Representative, prefabricated joint fittings shall be used at all intersections of ribbed type waterstops.

- 2) Waterstops shall be connected to the prefabricated joint fittings by field splicing. Ends to be spliced shall be carefully cut with sharp knife so that the pieces will match as exactly as possible and the continuity of the waterstop ribs and of its tubular center axis will be maintained.
 - 3) Where splicing in the waterstop is necessary, it shall be made with a thermostatically controlled splicing iron in accordance with manufacturers recommendations. The same technique shall be used in making all T's, X's and other fittings required. Maximum temperature shall not cause burning or charring of plastic, and in no case shall it exceed 460 degrees F.
 - 4) All joints with waterstops involving more than two (2) ends to be jointed together and all joints which involve an angle cut, alignment change or the joining of two (2) dissimilar waterstop sections shall be prefabricated by the Contractor prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.
 - 5) Finished splices shall provide a cross section dense and free of porosity with a tensile strength of not less than 80-percent of unspliced material.
- e. Form work shall be designed to positively hold the waterstops in alignment within the joint during and after concrete is poured. Unless otherwise approved, waterstops shall be wired to reinforcing steel at a maximum spacing of 12-inch centers to prevent lay over during the pouring of concrete.
 - f. The installation of waterstops and the method used to hold the waterstop in proper position during and after placement of concrete shall be acceptable to the Owner's Representative before concrete placement is begun.
 - g. Concrete being placed around waterstops shall be vibrated to obtain impervious concrete free of voids in the vicinity of all joints.
 - h. In the event of damage to a waterstop or adjacent forms during placement of concrete, the damaged portions of the forms and waterstop shall be removed and repaired in a manner acceptable to the Owner's Representative.

PART 4: SPECIAL PROVISIONS

None.

SECTION 03152
EXPANDING HYDROPHILIC WATERSTOP

PART 1: GENERAL

1.1 SCOPE

- a. Furnish and install expanding hydrophilic waterstop as specified herein.
- b. Hydrophilic waterstops shall only be used where specifically shown on the drawings. If not clearly shown on the drawings for a particular concrete joint, a PVC waterstop in accordance with section 03151 shall be installed. Expanding hydrophilic waterstops are generally prohibited unless specifically shown on the drawings.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*) as well as marking these on the applicable submittal page(s).
- b. Submittals for Review: Submittals & shop drawings including complete specifications, descriptive drawings, and literature for all materials proposed for use, including but not limited to the following.
 - 1) Each size and type of waterstop to be used.
 - 2) Submit certificate signed by manufacturer certifying waterstop consists of 75% sodium bentonite and 25% butyl rubber compound.
 - 3) Adhesive for use with the waterstop to be by the same manufacturer.

1.3 QUALITY ASSURANCE

- a. Verification of Details: Contractor to notify the Owner's Representative immediately of any detail, note, or specification which does not comply with current manufacturer's installation requirements.
- b. Adhesive: Use manufacturer's standard adhesive.
- c. Installation Instructions: Components and installation procedures shall be in accordance with current manufacturer's printed specifications and recommendations. Verify technical data submittals are the most current with manufacturer.
- d. Concrete: Concrete to receive waterstop shall be sound structural grade with a smooth finish, free of debris, oil, grease, or other foreign material.

PART 2: PRODUCTS

2.1 WATERSTOP

- a. Waterstop shall consist of 75% sodium bentonite and 25% butyl rubber (bentonite waterstop) formed into the shapes and sizes summarized below.

- 1) Vertical and Horizontal Concrete 8" Thick or Greater: 1" x ¾" flexible strip of bentonite and butyl rubber compound (rectangular cross section) for use in concrete construction joints shall be RX 101 as manufactured by CETCO or equal.
- 2) Precast Pump Station Wetwell Barrel Cast into Concrete Base Slab: 1¼" x ½" flexible strip of bentonite and butyl rubber compound (trapezoidal cross section) with reinforcing plastic scrim embedded in the top surface for high tensile strength shall be RX 101T as manufactured by CETCO or equal.
- 3) Vertical and Horizontal Concrete 5" to 8" Thick: ¾" x ⅜" flexible strip of bentonite and butyl rubber compound (half-circle cross section) for use in construction joints shall be RX 102 as manufactured by CETCO or equal.

2.2 ADHESIVE

- a. The specified hydrophilic waterstop is not a self-adhering product, and requires an adhesive be applied to the concrete, metal or PVC pipe surface to which the waterstop is to be secured.
- b. Waterstop adhesive shall be a single component polyether moisture cure sealant/adhesive specifically designed as a waterstop adhesive. Waterstop adhesive shall be CETSEAL sealant/adhesive as manufactured by CETCO or equal.
- c. Keep adhesive from freezing. Application rate: ¼" (6 mm) bead.

PART 3: EXECUTION

3.1 MATERIAL DELIVERY, HANDLING AND STORAGE

- a. Deliver materials as factory packaged, sealed and labeled. Handle and protect as necessary to prevent damage or deterioration during shipment and handling. Store materials in a dry location secure from weather and construction operations. Remove damaged materials from the site and dispose of in accordance with applicable regulations.

3.2 GENERAL

- a. Hydrophilic waterstops shall be used only where specifically shown on the drawings.
- b. Unless otherwise shown or specified, all waterstops shall be fully continuous for the extent of the joint.
- c. Suitable precautions shall be taken to protect the exposed hydrophilic waterstop from moisture during construction and until the exposed portion of the waterstop is embedded in concrete (*ie. protect from precipitation, washdown water and/or standing water*).
- d. Place and vibrate concrete to consolidate the concrete around the waterstop without voids. Do not pour concrete directly on waterstop where this could dislodge the waterstop (*ie. where waterstop is applied on vertical or steeply sloped surfaces*), or allow vibrator to come into direct contact with the waterstop.

3.3 EXAMINATION

- a. Installer shall examine concrete and conditions under which work is to be performed and verify that conditions are satisfactory for the installation of hydrophilic bentonite waterstop.
- b. Installer shall notify the Owner's Representative of circumstances detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions are corrected.

3.4 WEATHER CONDITIONS & PROTECTION OF WATERSTOP

- a. Installation shall not proceed when work areas are flooded or where there is moisture that would cause bentonite waterstop to hydrate or swell; nor when precipitation can be reasonably anticipated before bentonite waterstop can be properly installed and protected from moisture. Consult with manufacturer's representative as necessary to ensure adequate protection of bentonite waterstop.
- b. The Contractor shall be fully responsible for providing, installing, constructing, and/or erecting any and all temporary protective measures necessary to shelter the work area where the bentonite waterstop is installed, as required, to ensure that the waterstop remains dry until placement of concrete, all at no additional cost to the Owner.
- c. Moisture Protection. The bentonite waterstop shall not be pre-hydrated by submersion for any period, and shall not be in contact with water prior to encapsulation in concrete. If the product exhibits swelling prior to encapsulation in concrete, it shall be replaced with new material. Removal of formwork required to replace bentonite waterstop which has been exposed to moisture or water and needs to be replaced, will not entitle the Contractor to additional contract time or an increase in the contract price.

3.5 WATERSTOP INSTALLATION

- a. Remove all dirt and debris, surface coatings and sealers before application. Clean all debris, dirt and rocks from dry concrete surface. Concrete to be free of large voids and projections. Prepare metal by removing rust, scale and oil residue.
- b. Apply a continuous bead of CETSEAL adhesive, remove release paper on back of waterstop, and firmly press the entire length of waterstop onto the adhesive. For vertical and overhead applications, hold firmly in place for a minimum of 15 seconds to assure adhesion. Apply waterstop within 15 minutes of adhesive installation, or prior to adhesive skinning over and curing (whichever is less). CETSEAL adhesive may be applied to damp surfaces, but not in standing water. Do not apply sealant at temperatures below 36°F.
- c. Joints in Bentonite Waterstop. Tightly butt waterstop ends together to form a continuous waterstop. DO NOT OVERLAP ENDS. Where required, cut waterstop with sharp knife or utility blade to fit coil ends together without overlapping.
- d. Removal of Temporary Support Tape. If duct tape (or similar) is used to hold the waterstop in place on vertical surfaces (while the adhesive sets up), the tape shall be removed immediately prior to concrete placement. Contractor shall coordinate to ensure that removal of the tape is verified by the Owner's Representative or inspector.

- e. Protect from moisture as specified herein, until concrete is placed around the hydrophilic waterstop.
- f. Sleeved Pipe Penetrations. After the wall sleeve is cleaned and dry, install one bead of the bentonite waterstop around the outer diameter of the wall sleeve, on the water pressure side of the integral waterstop ring. For PVC or plastic sleeves, RX-103 shall be used.
- g. Pipes Cast into Concrete Walls. After the pipe through the wall is cleaned and dry, install one bead of the bentonite waterstop around the outer diameter of the wall pipe, on the water pressure side of the integral waterstop ring. For PVC or plastic sleeves, RX-103 shall be used.

3.6 JOINING BENTONITE WATERSTOP TO PVC WATERSTOPS

- a. Where bentonite waterstop needs to be joined with existing PVC dumbbell waterstop that has already been cast into concrete *(or to fill gaps in new PVC dumbbell waterstop which is left out to provide access for concrete placement)*, the bentonite waterstop shall be installed on the exterior side (ie. water pressure side) of the PVC dumbbell waterstop.
- b. The bentonite waterstop shall be in direct contact with the PVC waterstop and shall overlap the PVC waterstop by a minimum of 6-inches where possible, but in no case shall the overlap be less than 3 inches.

PART 4: SPECIAL PROVISIONS

None.

SECTION 03200
CONCRETE REINFORCEMENT

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing concrete reinforcing steel of the quality, type and size as specified herein or shown on the drawings, including all tie wire, clips, supports, chairs, spacers and other appurtenances as required for the completion of the work.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*) as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item) , including but not limited to the following.
 - a) Reinforcing bar and/or reinforcing wire utilized in reinforced precast or cast-in-place concrete products.
 - b) Anchor bolts & Inserts.
 - 2) Number of Submittals.
 - a) Unless otherwise approved in writing by the Owner's Representative (for each structure), no more than one reinforcing steel submittal shall be prepared by the Contractor and submitted for each structure, including (as applicable) all rebar for concrete footings, foundations, slabs, beams, supports, and all CMU block walls.
 - b) Where a single submittal includes reinforcing steel for more than one structure, the submittal shall be divided into sections clearly labeled for each structure.
 - 3) Rebar Shop Drawing & Associated Documentation:
 - a) Shop Drawings, including bending lists and placing drawings, shall be submitted to Owner's Representative for review and approval prior to cutting or fabricating any reinforcing.
 - b) Bending lists and placing drawings shall indicate location for all bars, including straight bars, as well as the number of each bar provided.
 - c) Contractor shall allow sufficient lead time to permit detailing, submission, and review of placing drawings, fabrication, and delivery of bars to be accomplished within the framework of the established construction schedule.

- d) Contractor shall thoroughly review and redline all shop drawings prior to submittal to the design team.
- 4) Alternate Splicing Systems.
 - a) Submittals shall include detailed manufacturer's information and certifications for any rebar splice system other than that shown on the drawings, including a specific request for each location where such alternate splice system is proposed for use, as well as a copy of a current testing & evaluation report certifying that the splice system fully meets the requirements of any and all applicable building codes, ACI standards, and other applicable state/local codes & standards.
 - b) The location of any rebar splices which do not fully conform with the information shown on the drawings (*ie. location or type of splices*) shall be specifically called out on the submittals to allow review by the structural engineer.
 - c) Where Form Saver threaded rebar couplings are proposed for use, the submittal shall include information on how concrete paste will be kept out of the second half of the coupling during concrete placement.
- 5) Submittals for record:
 - a) The Owner's Representative shall be given a copy of the weigh bill and invoice for each shipment delivered.
 - b) Certified results of at least one representative tensile and bending test for each size bar and fabric reinforcement furnished for contracts requiring 10,000 lbs of reinforcing steel or more, unless otherwise required.

PART 2: PRODUCTS

2.1 GENERAL

- a. Reinforcing bars shall be fabricated in accordance with dimensions shown on plans and reviewed bending and detail sheets.
- b. Bends for bars other than hooks, stirrups, and ties shall be made around a pin having diameter not less than the following:
 - 1) #3-#8 bars: 6 times the minimum thickness of the bar.
 - 2) #9 & larger: 8 times the minimum thickness of the bar.
- c. Forming and cutting tolerances shall be in accordance with current edition of Manual of Standard Practice for Reinforced Concrete Construction, published by Concrete Reinforcing Steel Institute.
- d. All bars shall be bent cold.
- e. Contractor shall not deviate from bar sizes on plans without written approval from the Owner's Representative. In no case shall bar substitution be allowed which would result in a smaller steel cross section than shown on plans.

2.2 REINFORCING STEEL

a. Structures & Slabs

- 1) Bar reinforcement shall be Grade 60 deformed bars meeting the requirements of ASTM A-615 or ASTM A-706 for welded connections.
- 2) Steel fabric shall conform to ASTM A-1064 and shall be furnished in flat sheets.

b. Pavements, Curbing and Walks

- 1) Reinforcing steel shall be Grade 60 deformed bars conforming to ASTM A-615, ASTM A-706 for welded connections.
- 2) Steel fabric shall conform to ASTM A-1064 and shall be furnished in flat sheets.
- 3) Dowel bars for load transfer joints shall be straight, smooth, round bars conforming to the dimensions shown on the drawings and shall be shop coated with a suitable rust inhibitor. For expansion joints, the dowel bars shall be fitted with expansion caps.

2.3 ACCESSORIES

- a. Tie wire shall be 16 gauge, black, soft-annealed wire.

b. Rebar Supports

- 1) All supports for reinforcement shall be of adequate strength and of the proper depth and number to securely hold the reinforcement in position during concrete placement.
- 2) Metal and plastic supports shall have a shape that is easily enveloped by the concrete.
- 3) Metal supports in contact with form work shall have plastic tips.
- 4) Where slabs are placed on forms, only metal or plastic supports will be permitted.
- 5) Where slabs are to be poured on firm ground or concrete mud mats, reinforcement may be supported by precast concrete blocks (dobies)(as detailed in CRSI Manual of Standard Practice, Chapter 3 with a minimum strength of 4,000 psi), metal or plastic supports.
- 6) Bar supports shall be of proper type for intended use and acceptable to the Owner's Representative.
- 7) Driving rebar or form stakes into the ground for support of rebar will not be acceptable.

c. Anchor Bolts and Inserts

- 1) Anchor bolts and inserts for anchor bolts shall be of types placed before the concrete is poured, unless otherwise specified, shown on the drawings, or approved by the Owner's Representative. All anchor bolts and nuts installed in underwater locations and for equipment exposed to the weather shall be Type 316 stainless steel. All others shall be Type 304 stainless steel.
- 2) The diameter, length and any bend dimensions of anchors shall be as shown on the drawings or as recommended by the equipment or machinery manufacturer, whichever is more stringent. Sleeves shall be provided as required or as shown for location adjustment.
- 3) Unless otherwise required or shown, use 3/4 inch minimum diameter and other geometry as shown on the drawings. In no case shall anchor bolts be more than 1/8-inch smaller than the anchor bolt holes provided by the manufacturer of the equipment or machinery.
- 4) Threaded screw anchors, self-drilling anchors and powder-activated fasteners are not permitted and shall not be used, except where noted in the specifications for a specific application, or where specifically shown on the drawings.
- 5) Where cast-in-place anchor bolts are not provided, drilled & epoxied threaded anchor rods shall be used, unless equivalent wedge anchors are proposed by the Contractor or the equipment supplier. However, well in advance of pouring concrete the contractor shall submit for the Owner's Representative's approval, drawings, information and specifications showing that the alternatives will meet the requirements of the work.

The size and embed depth of the stainless steel threaded rods shall meet or exceed the size and embed depth of the standard anchor bolts recommended/required by the equipment manufacturer (*or shown on the drawings*), for the specific equipment being provided, and based on the following.

- a) Epoxy adhesive for use with the 304 stainless steel threaded anchor rods shall be Simpson SET-3G High-Strength Epoxy Adhesive.
 - b) The size of the hole in the concrete shall be in conformance with the manufacturer's recommendations (*typically 1/8" larger than the threaded rod diameter*).
 - c) Installation shall fully conform with the manufacturer's recommendations, including hole cleaning & epoxy installation.
 - d) Contractor shall be responsible for coordinating all inspections and special inspections required for such drilled & epoxied threaded anchor rods by applicable building codes.
 - e) Contractor shall ensure that anchor bolts are not disturbed until epoxy is fully cured (*see SET-3G cure schedule, typically varies from 24 to 72 hours, depending on concrete temperature*), by either not allowing entry into the area for the entire cure time, OR providing secure anchored covers over the anchor bolts to ensure that they are not accidentally disturbed.
- 6) If anchor bolt configurations are proposed which are different from the manufacturer's cast-in-place bolt recommendations, or if configuration proposed is other than the drilled & epoxied option listed above, calculations shall be

provided *(by a licensed structural engineer retained by the Contractor)* showing that the proposed anchor bolt system is structurally equivalent to the standard J anchor bolts recommended/required by the manufacturer *(or shown on the drawings)*, for the specific equipment being provided.

- 7) Double Nuts. A minimum of two nuts and one washer of the same material as the bolt shall be furnished with each bolt, with both nuts being fully engaged on the anchor bolt threads.
- 8) Connections to existing concrete structures shall be made using approved dowels epoxied in place with an approved epoxy adhesive specifically designed for the application.

2.4 GRADE 60 ALL-THREAD REBAR & FORM SAVER COUPLINGS FOR SPLICES

- a. Where shown on the drawings, All-Thread Grade 60 Rebar used for splicing rebar where it penetrates formwork (Form Saver couplings) or at other locations, shall be a continuously threaded bendable alternative to traditional rebar, designed to be spliced with a mechanical threaded stop coupling capable of developing 100% of the bars tensile capacity at the splice location.
- b. The All-Thread Rebar shall be specifically designed, tested and certified for use as concrete reinforcing bar (including bending to standard rebar bend radii), and the threaded couplings shall be provided with integral stops to insure proper engagement without any torque tightening requirements, and capable of being field assembled with no special tools.
- c. The All-Thread Rebar system & associated couplings shall be tested and certified that the splice system fully meets the requirements of any and all applicable building codes, ACI standards, and other applicable state/local codes & standards.
- d. All-Thread Rebar system & associated couplings shall be Williams All-Thread Grade 60 Rebar and R52 Stop Couplings and/or C2DD Flange stop Couplings, or approved equal.

PART 3: EXECUTION

3.1 GENERAL

- a. All detailing, fabrication accessories and erection of reinforcing steel, unless otherwise noted, shall conform to the "Guide to Presenting Reinforcing Steel Design Details Manual of Standard Practice for Detailing Reinforce Concrete Structures" (ACI PRC- 315).
- b. Laps and splices shall conform to the requirements herein, drawing details, ACI CODE 318 or the Oregon Structural Specialty Code, whichever is more stringent.

3.2 DELIVERY, HANDLING AND STORAGE

- a. Delivery, handling and storage shall be in accordance with the following:
 - 1) Reinforcing steel, as delivered to the job site, shall be bound in bundles of either bent or straight bars identified by a numbered weatherproof tag. The tag numbers

shall identify the bars corresponding to those shown on the bar lists and placement drawings.

- 2) Deliver bars with suitable hauling and handling equipment.
- 3) Provide timbers or dunnage in storage area to keep bars off ground. No part of the reinforcing bars shall lay in or allowed to be coated with dirt or mud.

3.3 CLEANING

- a. Before placing, reinforcing steel shall be thoroughly cleaned of any loose mill scale, oil, earth, and other contaminants.
- b. After positioning, reinforcement shall be kept free of any coatings which will destroy or reduce bond, including oil, dirt, ice, or old concrete.
- c. Where there is delay in depositing concrete, reinforcement shall be reinspected and cleaned as required prior to concrete placement.

3.4 STRAIGHTENING AND REBENDING

- a. The steel shall not be bent nor straightened in any injurious manner. Bars with kinks or bends not shown on the drawings shall be rejected.
- b. Heating of reinforcement shall not be permitted unless specifically approved by the Owner's Representative.
- c. Bars partially embedded in concrete shall NOT be field-bent, except as specifically authorized by the Owner's Representative. Under no condition shall bars be field bent more than once.

3.5 PLACEMENT OF REINFORCEMENT

- a. Reinforcement of the size and shape shown on the approved shop drawings or as may be directed by the Owner's Representative, shall be placed where indicated on the drawings or as necessary to carry out the intent of the drawings and specifications.
- b. Reinforcement shall be securely tied at intersections as often as necessary to maintain the bars in their proper position during placement of concrete. Tie reinforcing bars in conformance with CRSI recommended practice for placing reinforcing steel (current edition).
- c. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- d. No reinforcing bars shall be driven nor forced into concrete after it has obtained its initial set.
- e. **Welding** of reinforcing is prohibited unless specifically noted on the drawing. Where welding is required, method to be subject to approval of the Owner's Representative and in conformance with Oregon Structural Specialty Code.
- f. All bars shall be supported by concrete, metal or plastic supports, spacers, or metal hangers

specifically designed to support reinforcing.

- g. Driving rebar or form stakes into the ground for support of rebar will not be acceptable.
- h. Bars in addition to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at no additional cost to the Owner.
- i. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than three (3) feet on center in any direction. The practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.
- j. Cover Over Bars
 - 1) The clear space between the outside face of reinforcing bars and the surface of concrete shall conform to the following dimensions, except as otherwise shown on the drawings:

LOCATION		MINIMUM COVER (inches)
Concrete in Contact with Earth.		
Formed Walls & Columns		3"
Slab on Ground (<i>Slab on Grade</i>) & Grade Beams		3"
Concrete in Contact With or Over Water.		
All Members		2"
Concrete not in contact with or located over water, and not in contact with earth.		
Slabs & Walls	#11 & smaller	¾"
	#14 & #18	1½"
Columns, Beams & Girders		1½"
Concrete tilt-up panels cast against a rigid horizontal surface.		
#8 & smaller		1"
#9 through #18		2"

k. Spacing of Bars

- 1) The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than 1-inch.
- 2) Where reinforcement in beams or girders is placed in two (2) or more layers, the clear distance between layers shall be not less than 1-inch.
- 3) In columns, the clear distance between longitudinal bars shall not be less than 1½ times the bar diameter, nor less than 1½ times the maximum size of the coarse aggregate, nor less than 1½ inches.

l. Location Tolerances

- 1) Reinforcing bars may be moved within allowable tolerances shown below to avoid interference with other reinforcing steel, conduits, other embedded items or openings.
- 2) Placement of reinforcing steel to conform to the following tolerances:

LOCATION	TOLERANCE
Height of top and bottom bars (Beams and Slabs).	±1/4 inch
Lengthwise locations and spacing in slabs and walls.	±2 inches
Lateral spacing of bars in joints or beams.	-0" to +1/4"
Stirrup spacing.	±1 inch in any one stirrup and ±1 inch in end stirrups.

- 3) Bars may need to be moved to avoid interference with other reinforcement steel, conduits or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Owner's Representative. Additional bars may be necessary to prevent cracking or provide additional reinforcement in this case and shall be provided by the Contractor at no additional cost to the Owner.

m. Minimum Reinforcing

- 1) Where specific reinforcing is not shown or noted on the drawings, the contractor shall provide all concrete walls with 0.25 percent reinforcing steel evenly spaced all ways unless otherwise noted.
- 2) 24-inch by 24-inch horizontal corner bars shall be provided at all wall corner intersections (both ways for T wall intersections) unless otherwise noted.

n. Reinforcement Around Openings

- 1) When it is necessary to cut reinforcing bars to accommodate pipe or other openings (and where not shown otherwise on the drawings), an equivalent area of steel shall be placed around pipe or opening and extended on each side sufficiently to develop bond in each bar as approved by the Owner's Representative.

When welded wire fabric is used, extra reinforcing shall be provided using deformed bars.

- 2) Unless otherwise specified or shown on the drawings, reinforcement shall be provided around all openings as follows:
 - a) Place two (2) #6 bars over, two (2) #6 bars under, and two (2) additional #5 bars each side of all openings.
 - b) Horizontal bars around openings shall be opening width plus 3'-6" on each end, minimum.
 - c) Vertical bars around openings (or at wall ends) shall be story height minimum, plus 24-inches bar height for multistory structures to ensure bars extend across joints between stories.
 - d) Place two (2) vertical #5 bars at all discontinuous wall ends.

3.6 SPLICING

- a. Splice Length. The ends of spliced reinforcing bars shall overlap at least 48 bar diameters (*unless longer splice lengths are shown or noted on the drawings*) and in no case less than 24 inches (including where All-Thread rebar is spliced to standard deformed rebar).
- b. Adjacent Splices To Be Offset. As a minimum, the splices in adjacent bars shall be staggered and offset by the full required splice length (*ie. legs of adjacent splices shall not overlap*).
- c. Full Contact Required at Splices. In all splices, bars shall be placed in contact and wired together.
- d. Splices not Shown or Noted on Drawings. If it is necessary to splice reinforcement at points other than shown on plans, character of splice shall be subject to approval by the Owner's Representative.
- e. Welded Wire Fabric Splicing. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each two (2) running feet. Wires shall be staggered and tied in such a manner that they cannot slip.
- f. Spiral Splices. Splices in column spiral reinforcement, when necessary, shall be made by a lap of 1½ turns minimum.
- g. Form Saver Couplings.
 - 1) Where Form Saver threaded rebar couplings are proposed and/or approved for use by the Owner's Representative, all couplings shall be provided with a means

for positively keeping the concrete paste out of the second half of the coupling during concrete placement.

- 2) Complete removal of any concrete paste that gets into the coupling during concrete placement shall be the sole responsibility of the Contractor, as required, to ensure that the All-Thread Rebar fully seats in the coupling to the full design depth.

3.7 STANDARD HOOK LENGTH

- a. Where standard hooks are noted on the drawings or specified, the hook length shall not be less than 12 bar diameters for 90° bends, or 4 bar diameters for 180° bends (*measured from the center of the bend radius*), or the length shown on the drawings, whichever is greater.
- b. Where stirrup/tie hooks are noted on the drawings or specified, the hook length shall not be less than 12 bar diameters for 90° bends, or 6 bar diameters for 135° bends (*measured from the center of the bend radius*), or the length shown on the drawings, whichever is greater.
- c. Where seismic stirrup/tie hooks (*135° seismic hook*) are noted on the drawings or specified, the hook length shall not be less than 6 bar diameters or 3" minimum (*measured from the center of the bend radius*), or the length shown on the drawings, whichever is greater.
- d. Bend diameters shall conform with CRSI standards.

3.8 PLACEMENT OF REINFORCING IN EXISTING CONCRETE STRUCTURES

- a. Dowels or other reinforcing bars which are shown on the drawings extending into existing concrete structures shall be placed as follows:
 - 1) A hole shall be drilled into the existing concrete structure a minimum of 2 inches larger than the diameter of the reinforcing bar. Hole shall be 15-inches deep unless otherwise noted on the drawings.
 - 2) Place reinforcement and pack remaining area around bar with an epoxy non-shrink grout.

3.9 SUPPORTS

- a. Metal, plastic, or precast concrete spacer blocks of the required thickness shall be wired to wall and column steel to assure required concrete clearance & rebar offsets.
- b. Steel fabric shall be supported on a spacing not to exceed a 3' x 3' grid.

3.10 GRANULAR BASEROCK or MUD MATS

- a. Unless greater baserock thickness is required or specifically noted on the drawings, all rebar shall be installed on dobies over the top of 4-inches minimum of compacted granular baserock (*3/4"-0 granular baserock material unless otherwise specified*).
- b. When granular baserock is allowed to be omitted, and if the ground is too soft to support reinforcing steel supports, the Contractor shall construct concrete mud mats. Concrete for mud mats shall be minimum 2000 psi concrete and shall not be less than 3-inches thick.

Bottom of excavations shall be free of water when mud mats are placed.

3.11 **INSPECTION & APPROVAL OF REINFORCING STEEL REQUIRED**

- a. Reinforcing steel shall be in place and approved by the Owner's Representative prior to placing any concrete. It is the Contractors responsibility to see that the reinforcing steel is securely and properly supported in the correct position and that all embedment items including electrical conduit is correctly installed before calling for inspections
- b. Contractor shall notify the Owner's Representative a minimum of forty-eight (48) hours (*ie. two business days*) prior to inspections being needed.
- c. The Owner's Representative may at his option require the use of inspection or placement cards if deemed necessary.
- d. Any inspections (*or special inspections*) required under the building permits for the project are separate from the inspection by the Owner's Representative, and shall be arranged directly by the Contractor.

PART 4: SPECIAL PROVISIONS

None.

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and placing concrete for site construction of foundations, slabs, walls, floors, columns, beams, pavements, curbing, conduits and other structures as required.

1.2 ASTM STANDARDS

- a. The manufacture, delivery and installation of cast-in-place concrete shall be in accordance with requirements of ASTM C-94 and applicable documents of that standard, except as modified herein.

1.3 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*) as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) Mix designs for each type and class of concrete, including required laboratory testing data, as well as historic compressive strength results for the mix design.
 - 2) Certified test reports from the manufacturer of the cement and any admixtures used.
 - 3) The location of all joints not shown on the drawings shall be submitted to the Owner's Representative for review and approval.
 - 4) Plant Certification - Laboratory testing certificates or plant certification as outlined herein.
 - 5) Batch Tickets - The manufacturer of the concrete shall furnish delivery tickets to the Owner's Representative at the unloading site in conformance with the certification required in ASTM C-94.
 - 6) Copies of all quality control field and laboratory testing required by this section, including break results.

1.4 PROJECT TESTING, LABORATORY SERVICES & QUALITY CONTROL

- a. Quality control/testing services shall be provided by an independent certified laboratory retained by the Contractor Owner, and shall be in accordance with the requirements of these Contract Documents. This requirement shall not limit or restrict the concrete supplier from performing his own quality control testing. The testing by the independent laboratory shall include:

- 1) The laboratory shall make scheduled quality control tests consisting of the following as a minimum per ACI SPEC-301 (****see below*):
 - a) Compressive strength
 - b) Slump
 - c) Temperature & Density
 - d) Air entrainment content
 - e) Yield

****ACI SPEC-301 defines field QC testing to include composite sampling by ASTM C172, slump by C143, air content by C231 or C173, temperature by C1064, density by C138, preparing compressive strength test cylinders by C31, testing cylinders by C39.*

b. Schedule of Strength Tests:

- 1) Three Test Cylinders – A minimum of three test cylinders shall be made from the initial pour each day, and for each 100 C.Y. of concrete poured each day, or whenever there is a visible change in the slump or consistency of the concrete

Upon case-by-case written approval by the engineer (*for very large concrete placements*), testing frequency may be increased to a maximum of once for each 150 C.Y. per ACI SPEC-301-20.

- 2) Slump & Air Tests in Conjunction with Cylinder Samples - When cylinder samples are made, the slump and air tests shall be made using concrete from the same batch.

c. Concrete Sampling Location:

- 1) Samples of concrete used for determining air content and slump, and for test cylinders and beams, shall be taken at the point of discharge into the structure unless otherwise directed by the Owner's Representative.
- 2) When concrete is pumped, concrete samples for slump, air content and test cylinders shall be taken at the discharge end of the pumping conduit.
 - a) If the pumping conduit is raised or lowered significantly from its placement position in order to facilitate the taking of such concrete samples, adequate concrete mix shall be discharged from the hose (*prior to taking to sample*) to ensure that a representative sample is obtained.

d. Portion of Load Concrete Sample Is To Be Taken From:

- 1) Samples of concrete used for determining air content and slump, and for test cylinders and beams, shall be taken by passing a receptacle completely through the discharge stream, or by completely diverting the discharge into a sample container.
- 2) Samples shall be taken from the middle portion of the batch to ensure a representative sample (*generally after approximately 25% of the load has been discharged*). In no case shall samples be taken before 10% or after 90 % of the batch has been discharged.

- e. If the concrete slump or air content are not within the specified tolerances, then stop production until concrete within the specified tolerances can be provided.
- f. Contractor's Responsibility:
 - 1) Any materials or products installed which do not meet the requirements as contained herein, including 28 day compressive strength, may be ordered removed and replaced at the discretion of the Owner's Representative, at no additional cost to the Owner.
 - 2) Production of concrete to meet specified requirements shall be the Contractor's responsibility.
 - 3) Field quality control (QC) needs to be executed by personnel qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1.
 - 4) The Contractor shall not be required to furnish an ODOT certified Concrete Control Technician. However, this shall not relieve the Contractor of the responsibility to assure that all concrete work conforms to the requirements contained herein.
- g. Standard Testing Specifications:
 - 1) Test specimens shall be made in accordance with "Standard Practice of Making and Curing Concrete Test Specimens in the Field," ASTM C-31.
 - 2) Tests for compressive strength shall be performed in accordance with "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens," ASTM C-39.
 - 3) Tests of beam specimens shall be made in accordance with "Standard Test Method for Flexural Strength of Concrete" (using simple beam with center point loading), ASTM C-293.
 - 4) Slump tests shall be made using "Standard Test Method for Slump of Hydraulic Cement Concrete," ASTM C-143.
 - 5) Air content shall be determined for concrete mixes composed of sand, gravel and stone aggregates by use of "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method," ASTM C-231. Where slag aggregate is used, the air content shall be determined by use of "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method," ASTM C-173.
 - 6) Concrete density by ASTM C138 and concrete temperature by ASTM C1064.

1.5 CONCRETE MIX DESIGN & SUPPLIER QUALITY CONTROL

- a. The Contractor or their supplier shall provide initial mix designs and cooperate with the laboratory in adjusting mixes to produce specified classes of concrete within the limiting requirements herein.
- b. Mix designs provided by the Contractor shall include the weight in pounds of fine aggregate, coarse aggregate, cement and water per cubic yard of concrete; the sacks of cement per

cubic yard of concrete; the gallons of water per sack of cement; gross weight and yield per cubic yard of concrete; weight in ounces of admixture per sack of cement; slump; air content; and compressive strength of test cylinders at 7 days and 28 days. Weight of fine and coarse aggregate shall be determined in the saturated, surface dry condition.

- c. The mix designs shall be tested by an independent laboratory. The laboratory shall test and produce reports of mix designs for all concrete incorporated in the work.
 - 1) Test reports shall include all information required for the Contractor's design mix specified herein, and shall state "Specifications Are/Are Not Met."
 - 2) The laboratory shall adjust concrete mixes only as required to obtain a product in conformance with the specified limiting requirements.
 - 3) The mix design of all concrete must be approved by the laboratory prior to submittal to the Owner's Representative for his approval. The design mix must be approved by the Owner's Representative before starting concrete production.
- d. Concrete Mix - Quality control tests for concrete mix shall be performed on the first day of concrete production and for every following day when 20 cubic yards (C.Y.) or more of concrete is delivered to the site.
- e. Aggregate Analysis - Aggregate analysis shall be made for each source of aggregate and for each month that concrete is placed. Make fine and coarse aggregate analysis as required in ASTM C-33.
- f. Production Inspection: When concrete is procured from a central batching plant or transit mixers are used, the Owner may, at his option, provide a representative at such plant to check the proportioning of aggregates, water and mixing time.

1.6 CONCRETE PLANT

- a. Plant equipment and facilities shall be in accordance with applicable requirements of ASTM C-94 and as specified herein.
- b. Equipment shall comply with the following requirements:
 - 1) The accuracy of the weighing equipment shall conform with the requirements of the United States Bureau of Standards.
 - 2) Equipment shall be capable of compensating for the varying weight of moisture contained in the aggregates or for changing the proportionate batch weights.
 - 3) The equipment shall be capable for accurately controlling the weight of the cement and aggregate.
 - 4) The equipment shall be so arranged as to permit the convenient removal of overweight material.
 - 5) Standard testing weights and other necessary equipment for testing the accuracy of the weighing equipment shall be available at the plant at all times.

c. Plant Inspection:

- 1) A qualified representative of the testing laboratory shall inspect the plant and determine if the necessary facilities and equipment are available and adequate for scheduled production of concrete as specified.
- 2) If the plant does not meet requirements, the Contractor shall be informed of the deficiencies so that they may be corrected.
- 3) When in the opinion of the laboratory representative, the plant meets the requirements for specified production, they shall so notify the Owner's Representative in writing. The notification shall include a list of all major facilities necessary for use in production of specified concrete for use in the project.

d. Certification of Plant: In lieu of the requirements of a, b, and c above, the Contractor may submit a January 1, 1976 or later edition of the National Ready Mixed Concrete Association's "Check List for Certification of Ready Mixed Concrete Production Facilities," executed and certified for conformance by a Registered Professional Owner's Representative.

- 1) Production of concrete for the project shall not be started until the above plant inspection or certifications has been completed.

1.7 MIXING AND TRANSPORTING CONCRETE

a. Types of Mixers: Concrete may be mixed in portable mixers located at the job site, in central plant mixers or in truck mixers. Mixers of any type shall conform to the requirements specified herein.

- 1) Portable and central plant mixed concrete shall be mixed in approved batch mixers of the rotary drum type having sufficient capacity to ensure continuous delivery at the required rate, except that relatively small quantities may be mixed by hand by special permission. The mixing drum shall be kept free of set concrete at all times. A water storage tank equipped with a gauge glass and an accurate measuring device shall be provided to determine the exact amount of water added to each batch. The measuring device shall be readily adjustable and so designed that it can be locked after setting and that the amount of added water cannot be altered after such setting. Mixing shall continue at least one minute at the manufacturer's rated speed of the drum after water, and all aggregate and cement have been added and until every particle of aggregate is coated with mortar and the whole mass uniform in color and homogeneous. The Contractor shall supply a discharge locking device so designed that concrete cannot be discharged in less than the required mixing time. The mixer shall also be equipped with a gong which sounds at the termination of the mixing time and with an approved batch meter which will accurately record each batch delivered.
- 2) Truck mixed concrete shall be mixed completely in truck mixers equipped with specified water measuring control and locking devices. Each batch of concrete shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of the equipment as mixing speed. Additional mixing shall be at the speed designated by the manufacturer of the equipment as their rated capacity. Trucks shall be equipped with counters that

register the number of revolutions of the drum or blades.

b. Transporting Mixed Concrete

- 1) Concrete mixed in a central mixing plant shall be transported to the point of delivery in a truck agitator or in a truck mixer operating at agitating speed. Mixers and agitators shall be operated within the limits of the capacity and speed of rotation designated by the manufacturer of the equipment.
- 2) Delivery and discharge of mixed concrete shall be completed within ninety (90) minutes after the introduction of the mixing water to the cement and aggregates.

In hot weather or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85°F or above, this time limitation shall be shortened to sixty (60) minutes.

- a) Any proposal to extend the times beyond these limits shall be approved in writing a minimum of 2 weeks prior to concrete placement, based on detailed submittal information documenting how the slump/workability, air content and temperature of freshly batched concrete can be maintained beyond the limits provided in ASTM C 94/C 94M using hydration-controlling admixtures, workability retaining admixtures and other means as specified in ACI SPEC-305.1.

The decision to propose the use of any such additional admixtures remains the Contractors, subject to the fresh or cured concrete being able to meet all specification requirements.

The following note is provided in ASTM C 94/ C 94M is provided for reference regarding these technologies: *“Depending on the project requirements the technology is available to the manufacturer to alter fresh concrete properties (such as setting time, slump or slump flow, air content, etc.). On some projects the manufacturer may request changes to certain fresh concrete properties due to the distance or projected transportation time between the batch plant and the point of delivery.”*

Typical admixtures may include MasterSet DELVO hydration-controlling admixture and MasterSure Z 60 workability retaining admixture. Any such proposal shall include documentation demonstrating that the proposed admixtures have been used successfully to maintain the fresh properties of concrete beyond the 90-minute limit for concrete discharge provided in ASTM C 94/C 94M, including compressive strength break data using cylinders taken beyond the typical 90-minute time limit.

- c. Cold Weather: Concrete delivered in outdoor temperatures lower than 40°F shall arrive at the work having a temperature not less than 50°F nor greater than 90°F, unless otherwise approved in writing by the Owner’s Representative.

PART 2: PRODUCTS

2.1 GENERAL

- a. Whenever any material or product is indicated or specified by patent or proprietary name, name of manufacturer or model number, such specification is used for the purpose of establishing a standard of quality and facilitating the description of the material or process desired. Such specification of a particular product shall not be construed as acceptable under the above listed criteria. It shall be the Contractor's responsibility to provide certification as required above or provide an equal quality product for which certification can be provided.

2.2 MATERIALS

- a. Cement: Cement shall conform to the requirements of ASTM C-150, Type I, unless provided otherwise in the drawings or specifications.
- b. Supplementary Cementitious Materials:
 - 1) Fly Ash: ASTM C618, Class F or C.
 - 2) Slag Cement: ASTM C989, Grade 100 or 120.
 - 3) Silica Fume: ASTM C1240.
 - a) MasterLife SF 100; Master Builders Solutions or approved equal.
 - 4) Metakaolin: ASTM C618, Class N.
 - a) MasterLife MK 828; Master Builders Solutions or approved equal.
- c. Concrete Aggregate
 - 1) Fine Aggregate: Fine aggregate shall consist of natural sand composed of clean, hard, strong, durable, uncoated grains. It shall be free from injurious amounts of shale, clay lumps, soft or flaky particles and other unsound or deleterious substances. It shall conform to specifications for concrete aggregate, ASTM C-33.
 - 2) Coarse Aggregate:
 - a) Coarse aggregate shall consist of gravel, slag or broken stone composed of strong, hard, clean, durable, uncoated pebbles or rock fragments free from injurious amounts of shale, coal, clay lumps and soft fragments, dirt, glass and organic or other deleterious substances. It shall conform to ASTM C-33, Size 57, Class 4S. Slag shall weigh at least 75 lbs/cf and shall meet all requirements of the governing State Highway Specifications for slag aggregate.
 - b) Crushed stone and gravel shall be washed, if necessary, to remove dust, dirt or loam. All unsatisfactory materials shall be excluded from the work.
 - c) For thin sections a smaller maximum size stone shall be used when directed and approved in writing by the Owners Representative.
 - d) For heavy sections without rebar spacing concerns, a larger maximum size stone may be permitted if approved in writing by the Owners Representative, in which cases the gradation of other sizes shall be modified as directed.
- d. Water:
 - 1) Water used for concrete mixing/batching shall meet ASTM C1602 (*Standard*

Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete) and be clean, free from oil, acids, strong alkalis, vegetable matter or sewage contamination. All water shall be furnished at the Contractor's expense, preferably from City mains. Sources other than City water mains shall not be used unless approved by the Owner's Representative.

- 2) Agricultural water with high total dissolved solids (over 1000 mg/L TDS) shall not be used.

e. Admixtures:

- 1) General.

- a) All admixtures used on potable water infrastructure shall be NSF 61 certified.
- b) Approved admixtures may be used to improve workability provided the cement content is not reduced. No admixture other than air entrainment admixture shall be used unless approved by the Owner's Representative. All admixtures used shall be compatible with each other.
- c) The manufacturer of admixtures to be used in work shall submit a certification to Owner's Representative for their records, certifying that admixtures contain no chemicals, salts, or other products corrosive or harmful to steel reinforcement.
- d) Contractor not to use any admixtures until above certification has been submitted and approved by the Owner's Representative. Approval by the Owner's Representative shall not relieve the Contractor of providing a finished product meeting all specification requirements.
- e) Neither calcium chloride nor admixtures containing more than 0.1% intentionally-added chloride ions shall be added to the mix. Written certification that any chloride ion content in admixtures will not result in the concrete exceeding the total allowable chloride content.

- 2) Air entrainment admixtures per ASTM C-260: Air entrainment admixtures shall be introduced into the mix in quantities to entrain an optimum air content as specified within $\pm 1.5\%$.

- 3) Water-reducing admixtures per ASTM C494 Type A.

- a) Water-reducing admixtures shall conform to ASTM C-494. The water-reducing admixture shall be compatible with air-entrainment admixtures, if used.
- b) Manufacturer of water-reducing agents to be used in work to submit a certification to Owner's Representative for their records, certifying that water-reducing agent contains no chemicals, salts, or other products corrosive or harmful to steel reinforcement.

f. Bonding Agent: Bonding agent for bonding new concrete to existing concrete to be MasterEmaco ADH 327 RS as manufactured by Master Builders Solutions, Shakopee, MN,

or Sta-Crete as manufactured by Sta-Crete, Inc., San Francisco, California, or Epoxy Bond MPC, Code 2090-Special as manufactured by Edoco Technical Producers, Inc., Long Beach California, or an approved equal.

- g. Premolded Joint Filler: Premolded joint filler shall be bituminous type conforming to ASTM D-994 or D-173.
- h. Joint Filler: Joint filler conforming to ASTM D1751, non-extruding type.
- i. Concrete Curing Materials
 - 1) Materials for curing concrete shall conform to the following requirements:
 - a) Concrete curing compound shall contain a fugitive dye so that areas of application will be readily distinguishable. The curing compound shall be Select Cure CRB as manufactured by Select Products Co., Upland, CA; or equal.
 - b) Polyethylene sheet for use as concrete curing blanket shall be white and shall have a nominal thickness of 6 mils.
- j. Floor Hardener: Floor hardener shall be MasterKure HD 300 by Master Builders Solutions; Fluohard as manufactured by L&M Construction Chemicals, Inc.; Harbeton as manufactured by Nox-Crete Chemicals, Inc.; Pena-Lith as manufactured by W.R. Meadows, Inc.; or approved equal.

2.3 CONCRETE

- a. All concrete shall conform to the requirements of Oregon Structural Specialty Code except as modified herein.
- b. Classes of Concrete: The classes of concrete designate the specified minimum compressive strength in pounds per square inch of the concrete at 28 days. Unless otherwise approved in writing by the Owner's Representative, all concrete shall conform to the requirements listed below for each type of usage. Approval of an alternate mix design shall not relieve the Contractor of the responsibility for ensuring that the concrete meets all other specification requirements.

**TABLE 1
CONCRETE REQUIREMENTS**

Concrete Class	Maximum Water/Cementitious Material Ratio(*)	Minimum Cement Content Sacks/C.Y.	Slump (inch)		Air Content (±1.5%)	Intended Use
			Min.	Max.		
3300	0.46 (5.7)	6	3	6	4.5%	All Concrete not otherwise specified, including structures, bedding, encasement and thrust restraint.
4000	0.44 (5.1)	6.5	1	4	4.5%	Pavements, Floor Slabs

* Also shown in water (U.S. gallons) per 94 lb sack of cement.

- c. The minimum flexural strength of concrete for pavements, curbing and walks shall be as shown in Table 2.

TABLE 2
FLEXURAL REQUIREMENTS

Concrete Class	Flexural Strength (psi)		28-Day
	7-Day	14-Day	
4000	600	650	700

d. Water/Cementitious Materials Ratio:

- 1) Except by special permission from the Owner's Representative, maximum amounts of water (U.S. gallons), including the surface water carried by the fine and coarse aggregates per sack (94 lbs net) of cement, shall be that listed in Table 1. Standard methods shall be used for determination of surface moisture in the aggregates.
- 2) Concrete of the maximum strength, density and durability possible with the specified water/cementitious materials ratio is required. No increase of these ratios will be permitted.
- 3) Water shall not be added at the job site without specific approval by the Owner's Representative and shall not exceed the maximum w/cm ratio.

e. Minimum Cement Content: Each cubic yard of concrete shall contain the minimum number of sacks (94 lbs net) of cement listed in Table 1. The minimum amounts of cement listed shall be used, regardless of tests and design methods used.

f. Slump:

- 1) The proportions of aggregate to cement for concrete of the specified water/cement ratio shall be such as to produce concrete that can be puddled readily into the corners and angles of the forms and around reinforcement without excessive vibrating and without segregation of materials or collection of free water on the surface. In those portions of the structures where member dimensions and/or congestion, due to reinforcing steel, prevent the proper placement and consolidation of the concrete at the maximum slump specified, plasticizer shall be used by the Contractor in lieu of increasing the slump of non-plasticized concrete by the addition of water.
- 2) If concrete containing a plasticizer is approved, it shall have a maximum slump of 8-inches. If the plasticizer is added at the batch plant, the contractor shall provide manufacturer's documentation that the plasticizer will not reduce the set time of the concrete.

g. Adjustments to Mix Design

- 1) Consistency of the concrete shall be closely regulated and the proportions of fine and coarse aggregate shall be such as to produce no harshness in placing nor honeycomb in the structures.
- 2) If required, the mixture shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability and surface finish and

the Contractor shall be entitled to no additional compensation because of such changes. The Contractor shall cooperate in every way so that concrete of the desired quality will be obtained.

PART 3: EXECUTION

3.1 FORMS FOR CONCRETE

- a. Responsibility: It shall be the Contractor's responsibility to design, furnish, install and remove all form work and perform incidental work as required to produce concrete structures in conformance with the drawings.
- b. Design: Form work shall be designed to support all anticipated loads without movement or bending and to produce concrete structures conforming to the dimensions and contours shown on the drawings.
- c. Materials: Forms for exposed surfaces shall be made of approved material to produce a smooth surface with minimal joint marks.
- d. Chamfers. Unless otherwise specifically noted on the drawings or directed in writing otherwise by the Owner's Representative, above grade portions of concrete members and concrete slabs shall be provided with 3/4-inch chamfers on all exposed corners.

3.2 PREPARATION OF SURFACES FOR CONCRETING

- a. Place on Granular Baserock. Unless greater thickness is required or otherwise specifically noted on the drawings, all concrete shall be placed on a minimum of 4-inches of compacted granular baserock (*3/4"-0 granular baserock unless otherwise specified*).
- b. Granular baserock & earth surfaces shall be thoroughly and uniformly wetted by sprinkling prior to the placing of any concrete. These surfaces shall be kept moist by frequent sprinkling up to the time concrete is placed thereon. The surface shall be free from standing water, mud and debris at the time of placing concrete (*placement of concrete into standing water is prohibited*).
- c. The surfaces of all horizontal construction joints shall be cleaned of all concrete laitance, loose concrete or defective concrete and foreign material. Unless otherwise specified, such cleaning shall be accomplished by sandblasting or power washing followed by thorough rinsing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.
- d. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel and preparation of surfaces involved in the placing have been completed and accepted by the Owner's Representative. All reinforcement, anchor bolts, sleeves, inserts and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the Owner's Representative before any concrete is placed. Accuracy of placement is the responsibility of the Contractor. All surfaces of embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.

- e. All form surfaces in contact with the concrete shall be thoroughly cleaned of all previous concrete, dirt and other surface contaminants prior to use. Damaged form surfaces shall not be used.
- f. Wood form surfaces in contact with the concrete shall be coated with an approved release agent prior to form installation. The release agent shall be non-staining and non-toxic after thirty (30) days. Mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface of steel forms. All steel forms shall have the contact surfaces coated with an approved release agent. The release agent shall be effective in preventing discoloration of the concrete from rust and shall be non-toxic after thirty (30) days.
- g. Where concrete is to be cast against old existing concrete, the old concrete shall be thoroughly roughened to exposed, hard aggregate by sandblasting or chipping. Any additional surface preparation shall be as called for in the drawings.
- h. Dewatering. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or diverted out of the forms and clear of the work. Pumping or other necessary dewatering operations for removing ground water, if required, shall be the responsibility of the Contractor and will be subject to review by the Owner's Representative. No concrete shall be deposited in standing water, under water, nor shall any water be allowed to rise on any new concrete until the concrete has attained its initial set.
- i. Pipe, conduit, dowels, sleeves and other ferrous items required to be embedded in concrete construction shall be adequately positioned and supported prior to placement of concrete. There shall be a minimum of 2 inches clearance between embedded items and any of the concrete reinforcement. Securing embedments in position by wiring or welding them to the reinforcement will not be permitted.

3.3 FORM & REBAR INSPECTION & APPROVAL REQUIRED, NOTICE

- a. No concrete shall be placed without prior inspection of the forms, reinforcing and embedded items and approval from an authorized representative of the Owner's Representative, as well as any inspections required under the building permit(s).
 - 1) The Contractor shall contact the Owner's Representative and request form and rebar inspections a minimum of forty-eight (48) hours (*ie. two business days*) in advance, with such inspection scheduled far enough in advance of concrete placement to allow the Contractor to correct any deficiencies found (*one day minimum*). Any delays due to the need to correct deficiencies found shall be entirely the Contractor's responsibility.
 - 2) The Contractor shall notify the Owner's Representative a minimum of forty-eight (48) hours (*ie. two business days*) in advance of setting the second side of wall forms so that the construction joint preparation, water stop installation and reinforcing steel inspections can be conducted.
 - 3) It is the Contractor's responsibility to see that the forms are properly cleaned and oiled before being set, the construction joints properly prepared, reinforcing steel is securely and properly supported in the correct position and that all embedment items including electrical conduit is correctly installed before calling for

inspections.

- 4) The Contractor shall notify the Owner's Representative a minimum of twenty-four (24) hours in advance (*ie. one business day*) of any scheduled concrete placement.
- 5) The Owner's Representative may, at their option, require the use of inspection and/or placement cards if deemed necessary.
- 6) Any inspections (*or special inspections*) required under the building permits for the project are separate from the inspection by the Owner's Representative, and shall be arranged directly by the Contractor.

3.4 PLACING CONCRETE

a. General

- 1) The temperature of concrete when it is being placed shall be not more than 90°F nor less than 50°F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90°F, the Contractor shall employ effective means, such as precooling the aggregate and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90°F. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.
- 2) Dewatering, Incidental Water. See dewatering requirements above. No concrete shall be deposited directly into standing water. All concrete shall be placed so as to ensure that the leading edge of the concrete mass will push any incidental standing water out of the way, to a sump (*or to point outside of the forms*) where the water will be removed in conjunction with progression of the concrete placement.
- 3) Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the work. Concrete which is not placed in accordance with these specifications, or which is of inferior quality, shall be removed and replaced at the expense of the Contractor.

b. Placement Sequence:

- 1) Unless otherwise specified or authorized by the Owner's Representative, all multi-panel pours shall be poured such that panels are placed in an alternating sequence and allowed to cure before the adjoining panel is placed.
- 2) Unless otherwise shown on the drawing or approved by the Owner's Representative, concrete shall not be placed against the second side of the construction or expansion joints for at least seventy-two (72) hours after the first side has been placed.

c. Concrete Placement Scheduling & Sequencing:

- 1) Notice - The Contractor shall notify the Owner's Representative prior to placing concrete as required above, or as required in other specification sections. Where there is a conflict in notice requirements in this and other specification sections or on the drawings, the more stringent requirements shall apply.
- 2) Hours for Placing - Concrete shall be placed between the hours of 7 a.m. and 6 p.m., unless permission is given to extend that time. Large slabs (*as determined by the Owner's Representative*) shall not be placed after 12:00 noon on any last working day of the week.
- 3) Placement Sequencing, Interruption of Pour - Each concrete pour/placement shall be completed in a continuous operation with no interruption in excess of 45 minutes. Concrete placement sequencing shall remain the responsibility of the Contractor to ensure that fresh concrete is not placed against concrete (*in the same placement pour*) which has already reached its initial set (*see definition below*).
 - a) Initial Set - For purposes of this requirement, "initial set" is defined as when the concrete has hardened to the point where it can support a person without visible deflection or movement of the concrete (*regardless of definitions in any other standard or specification*). No re-tempered concrete shall be used under any circumstances (*concrete which has already achieved initial set as defined herein, but which can still be fluidized with a vibrator*).
- 4) Supporting Members, Placement Sequence - When columns, brackets or walls are to support beams or slabs, the concrete in the vertical or supporting member shall be deposited up to 1/2-inch above the bottom of the supported member and a period of at least 12 hours shall elapse for settlement before placing concrete in the horizontal member.
- 5) The Contractor shall allow for the installation of conduit, piping, sleeves, inserts or other items which are to be located below or within the concrete.

d. Conveying Concrete to Forms:

- 1) The method or device used for conveying the concrete from the mixer to its place in the work shall be such as to ensure against separation of the materials.
- 2) Dropping of concrete into forms shall be minimized, but in no case shall concrete be dropped more than 5 feet. Where placing operations involve concrete placement more than 5 feet below to the top of forms, it shall be deposited through pump tubes, tremie tubes or other approved pipes. If fixed pipes are used, they shall be assembled in sections not to exceed 5 feet in length, to allow removal as the concrete lifts are placed.
- 3) Where a chute is used, its slope shall be such as to allow concrete of the proper consistency to flow readily without separation of the ingredients.

e. Placing Concrete in Forms:

- 1) Concrete shall be deposited at or near its final position and carried up evenly with in the forms, in layers not exceeding 18-inches in depth. It shall be thoroughly

consolidated around and into contact with forms, reinforcement, pipes or other shapes built into the work, by spading and vibrating. Voids or pockets of coarse aggregate shall be prevented and the completed work shall be a solid, watertight unit with smooth form surfaces. A sufficient number of employees shall be available at all times to perform the work properly. Control of methods and practices of placing shall be subject to the approval of the Owner's Representative.

- 2) Where pipe or other shapes are built into the work, the concrete shall be placed from one side only and shall flow under the pipe or shape to the other side until all air is displaced.
- 3) The Contractor shall furnish and have in use sufficient vibrating equipment of a type and size to properly compact each batch immediately after it is placed in the forms. Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibration shall be of sufficient duration and intensity to remove all entrapped air and consolidate the concrete, but shall not continue so as to cause separation. "Dragging" of the concrete inside of forms or allowing it to flow by gravity to the ends of forms will not be permitted.
- 4) Spare Vibration Equipment Required On-Site. In addition to the concrete vibrators in actual use while concrete is being placed, the Contractor shall have available (on-site) a minimum of one (1) spare concrete vibrator in serviceable condition. No concrete shall be placed until it has been ascertained that all vibrating equipment, including spares, is in serviceable condition.

3.5 PUMPING OF CONCRETE

- a. Pumping of concrete will be permitted only with the Owner's Representative's approval. The pumping equipment must have two (2) cylinders and be designed to operate with one (1) cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor shall have a standby pump or crane and concrete bucket on site during pumping to provide assurance the concrete will be placed without cold joints in the event of pumping equipment breakdown.
- b. The minimum diameter of the hose (conduits) shall be 4 inches. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced. Aluminum conduits for conveying the concrete will not be permitted.

3.6 JOINTS AND BONDING

- a. Construction joints and control joints shall be placed as shown on the drawings. Waterstops shall be placed as specified in the applicable sections contained herein. Approval from the Owner's Representative must be secured for the placing of any construction joints not shown on the drawings.
- b. A minimum of 72 hours prior to concrete placement, Contractor shall provide to Owner's Representative with a drawing showing proposed location of all joints in large slabs.
- c. Keyways shall be provided in all construction joints. Unless shown wider or deeper on the drawings, all keyways shall be a minimum 1/3 of the wall width or slab thickness and 2-inches deep but not less than 4-inches wide x 2-inches deep.

d. Horizontal Construction Joints:

1) Lower Joint Surface Construction:

- a) Proposed joint surfaces shall be finished straight by use of temporary straight edges tacked to the inside of the form with the lower edges on the line of the joint. Concrete shall be placed above the joint as required to allow for consolidation and settlement.
- b) Joint surfaces shall have free water and scum removed and the keyway formed before the concrete attains its initial set.

2) Completing Joints:

- a) Preparation - Within 12 hours after the keyway has been formed, the lower surface of the joint shall be thoroughly cleaned by the use of wire brushes and all laitance and loose material removed so as to expose clean, solid concrete. Care must be taken not to loosen any of the coarse aggregate in the concrete. If for any reason this laitance is not removed within 12 hours after the concrete is placed, it shall be removed using such tools and methods as may be necessary to secure the results specified above.
- b) Bonding
 - (1) After the lower surface has been prepared and immediately before placing concrete above the joint, the lower surface shall be thoroughly wetted and flushed and a bed of mortar composed of one part Portland cement and two parts sand spread over the entire surface (2-inches minimum depth in wall pours). The mortar shall be thoroughly worked into all openings and crevices.
 - (2) The contractor may, at his option, propose to use an enriched mix for the first lift in lieu of the mortar bed. Mix design shall be submitted and approved by the Owner's Representative prior to use.

- 3) Control Joints: All control joints shall be sawcut within 8 hours of concrete placement.

3.7 FINISHING CONCRETE SURFACES

a. General

- 1) Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing or roughness of any kind, and shall present a finished, smooth, continuous hard surface.
- 2) Allowable deviations from plumb or level and from the alignment, profiles and dimensions shown are defined as tolerances and are specified herein. These tolerances are to be distinguished from irregularities in finish as described herein.
- 3) Aluminum finishing tools shall not be used.

b. UNFORMED SURFACES

- 1) The concrete for unformed surfaces shall be deposited between screeds to the finished floor or slab elevations making 1/8-inch allowance for shrinkage and any surplus water to the surface. Surfaces shall be sloped to drain as shown and care shall be taken not to leave hollows or pockets.
- 2) The finished surfaces shall be true and level so that a 10 foot straight edge will fit tight in all directions without permitting over 1/4-inch variance. Edges of concrete at expansion and pour joints shall be tooled to form a chamfer. No dusting or tempering will be permitted. Any concrete which takes its set before the required finish is obtained shall be cut out and replaced.
- 3) After placing and consolidating concrete, all unformed top surfaces of slabs, walls, curbs, gutter and steps, shall be brought to a uniform finished surface. The classes of finish specified for unformed concrete surfaces are defined as follows:
 - a) Finish U1: Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.
 - b) Finish U2: After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Floating shall be the minimum necessary to produce a surface of uniform texture and free from screed marks.
 - c) Finish U3: After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples and trowel marks. The finish shall be smooth and free of all irregularities.
 - d) Finish U4: Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to line of travel unless otherwise shown. The resulting surface shall be rough enough to provide a non-skid finish.

- 4) The schedule for finished unformed surfaces shall be as follows:

UNFORMED CONCRETE SURFACE SCHEDULE	
AREA	FINISH
Grade slabs and foundations to be covered with concrete or fill material.	U1
Floor slabs to be covered with grouted tile or topping grout and slabs to be covered with built-up roofing.	U2
All building and machine room floors, basin floors not receiving a grout topping, channel floors, top of interior walls, top of interior curbs, steps and walkways.	U3
Exterior walkways, curb, gutter, sidewalk and steps, top of valve or meter vaults, electrical pull boxes and catch basins.	U4

- 5) Floor Sealer Hardener (Surface Applied):

- a) Concrete floor hardener shall be furnished and applied to all interior exposed concrete floors, unless indicated otherwise on the drawings or in Part 4 of this section.
- b) Floors to receive hardener shall be cured, cleaned and dry with all work above them completed. Apply evenly, using three (3) coats, allowing 24-hours between coats. Products shall be applied in conformance with the manufacturer's instructions and as specified herein.

c. FORMED SURFACES:

- 1) Immediately following the removal of forms, the concrete shall be inspected for defects such as rock pockets, grout loss, damage from stripping forms, surface defects such as fins, offsets, bulges, excessive bug-holes or stains. All defective concrete work shall be repaired or removed and replaced to the satisfaction of the Owner's Representative. Any work which has not been constructed in accordance with the plans and specifications will be considered defective.
- 2) Correction of defective work shall be as directed by the Owner's Representative and specified herein. No defective work shall be patched, repaired or covered without prior inspection and approval of the Owner's Representative.
- 3) Holes left by tie-rod cones or taper ties shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with non-metallic grout.
- 4) The classes of formed concrete surfaces are defined as follows:
 - a) Finish F1: No special treatment is required after form removal except for curing, repair of defective concrete, treatment of surface defects or rock pockets, removal and grinding smooth of fins, offsets, bulges and projections, filling of tie holes, depressions and bug-holes 3/8-inch or larger in width or depth with mortar.

- b) Finish F2: First, all defective concrete shall be repaired, all fins, offsets, bulges and projections ground smooth, filling of tie holes and filling of depressions and bug-holes 1/4-inch or larger in width or depth with mortar.

Next, after wetting with water, the surface shall be uniformly covered with a grout consisting of one part cement and 1 to 1½ parts fine sand and sufficient water to produce a consistency of thick paint. White Portland cement shall be used for all or part of the cement in the grout to give the color required to match the concrete. The grout shall be uniformly applied to all surfaces with brushes or a spray gun and all air bubbles and pinholes shall be completely filled. Immediately after application of the grout, the surface shall be vigorously scoured with a cork or other suitable float to ensure complete filling of all voids and holes. While the grout is still plastic, the surface shall be finished with a sponge, rubber or other suitable float removing all excess grout. This finish shall be done at the time when the grout will not be pulled from the holes or depressions. After being allowed to thoroughly dry, the surface shall be vigorously rubbed with dry burlap to completely remove any dried grout. There shall be no visible film of grout remaining on the surface after this rubbing, and the entire cleaning operation of any area must be completed on the day it is started.

- c) Finish F3: First, all defective concrete shall be repaired, all fins, offsets, bulges and projections ground smooth and tie holes filled with grout.

The entire surface shall then receive a rubbed finish. Rubbing of concrete shall be started as soon as the mortar used in pointing insert holes and defects is thoroughly set. Immediately before starting to rub, the concrete shall be kept thoroughly saturated with water for a minimum period of two hours. Surfaces to be finished shall be rubbed with a medium coarse Carborundum stone, using a small amount of mortar on its face. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids have been filled and a uniform surface has been attained. The final finish shall be obtained by rubbing with a fine Carborundum stone and water. Such rubbing shall be continued until the entire surface is of a smooth texture and uniform in color.

- 5) The schedule for formed surface finish shall be as follows

FORMED CONCRETE SURFACE SCHEDULE	
AREA	FINISH
Formed concrete surfaces to be covered by backfill or coated with below grade waterproofing systems.	F1
Exposed concrete surfaces in water channels, below water surface of basins, inside meter and valve vaults, inside cells of hydraulic splitter boxes and weirs, all exposed exterior surfaces of foundations, basins, vaults and hydraulic structures to 6 inches below finished grade.	F2
Exposed concrete surfaces inside buildings, exposed concrete, exterior concrete surfaces of buildings.	F3

3.8 CURING OF CONCRETE

- a. Curing of concrete shall be in conformance with ACI SPEC-308.1 and as specified herein.
- b. Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures and mechanical injury; and shall be maintained with minimal moisture loss and at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The Contractor shall provide thermometers as required by the Owner's Representative.
- c. All concrete surfaces which are to receive a rubbed surface finish or surface protection of any type and all construction joints shall be cured with water curing methods only. Surfaces not covered by forms shall be covered with wet burlap, wet cotton mats or other approved means as soon after placing the concrete as it can be done without marring the surface and kept wet by the continuous application of water by means of suitable sprinkling devices for a period of not less than 7 days. Wood forms without liners, if left in place longer than 2 days after placing of concrete shall be thoroughly wet down at least once each day for the remainder of the curing period. Formed surfaces shall, after the removal of forms be cured in like manner for the remainder of the curing period, the entire surface of the concrete being thoroughly drenched with water and covered immediately after forms are removed. Portions of the covering material may be removed temporarily and continuous sprinkling stopped when and as necessitated by any required finishing operation.
- d. Waterproof membrane curing will be permitted in lieu of water curing on all concrete that is not to receive further treatment, except that it shall not be used over the surface area of construction joints. Immediately after the free water has disappeared on surfaces not protected by forms and immediately after the removal of forms, if such are removed before the end of the 7 day curing period, the concrete shall be sealed, by spraying as a fine mist, a uniform application of the curing material in accordance with ASTM C309, with the type to be used subject to the approval of the Owner's Representative. The application shall be such as to provide a continuous, uniform, water impermeable film without marring the surface of the concrete. The membrane curing material shall be applied in one or more separate coats at the rate in conformance with the manufacturer's recommendations.
- e. Compounds which combine curing, sealing, hardening, etc., are not permitted.

- f. Unless adequate precautions are taken to protect the surface of the membrane; workers, materials and equipment shall be kept off the membrane for the duration of the curing period.
- g. Curing water shall be approximately the same temperature as the concrete to alleviate temperature change stresses that could be detrimental to the concrete.

3.9 PLACING CONCRETE DURING COLD WEATHER

- a. Atmospheric Temperature: When concrete is placed at or below an atmospheric temperature of 40°F or whenever in the opinion of the Owner's Representative the temperature may fall below 40°F within the curing period, the water, aggregate or both shall be heated and suitable enclosures and heating devices shall be provided.
- b. Heating of Materials:
 - 1) Heating of mixing water shall be controlled to maintain uniform temperature from batch to batch. In no case shall the water be heated to a temperature greater than 140°F.
 - 2) Aggregate shall be uniformly heated to eliminate all frozen lumps, ice and snow; however, the aggregates shall not be heated to a temperature of more than 100°F.
- c. Placing and Curing:
 - 1) Temperature Control - The temperature of the concrete, when placed, shall be not less than 50°F and not more than 90°F. A satisfactory enclosure shall be provided and heated so that the temperature of the concrete will be maintained within this temperature range for a period of not less than 7 days. The enclosures and heating devices shall not be removed at the end of this period until the temperature of the concrete has been permitted to drop to atmospheric temperature at a rate of not to exceed 30°F per 24 hours. Thermometers shall be furnished by the Contractor so that the temperature within the enclosure may be determined.
 - 2) Concrete shall not be placed on frozen base material or in contact with forms, rebar or other materials having a temperature of less than 32°F or where any frost is present. If necessary, the forms, reinforcing steel and foundation materials shall be enclosed and heated before the concrete is placed. The temperature of all surfaces that the concrete will contact shall be raised above the freezing point for at least 12-hours prior to placing new concrete.
 - 3) The completion of suitable enclosures and the application of heat to bring the air surrounding the forms and deposited concrete to the specified temperature shall follow the placing of concrete as soon as possible.
 - 4) Heaters shall be vented at all times. No products of combustion shall be permitted to come in contact with concrete surfaces before 24 hours after finishing.
 - 5) If steam heat is used, curing compound shall not be applied until the use of steam is discontinued. If a heat source other than steam is used, a relative humidity of not less than 40% shall be maintained unless curing compound is used.

d. Form Insulation:

- 1) In lieu of heated enclosures, the Contractor may protect concrete in slabs more than 12-inches thick and in walls of structures by the use of insulation, if approved by the Owner's Representative.
- 2) Temperature Control - When form insulation is used, the concrete shall be placed at a temperature of not less than 50°F and not more than 90°F as directed by the Owner's Representative and maintained by the insulation at a surface temperature of the concrete of not less than 50°F and not more than 100°F. Sufficient thermometers shall be furnished and installed by the Contractor in such a manner that the surface temperature of the concrete may be readily determined. Whenever the surface temperature, as indicated by the thermometer readings, exceeds the specified maximum temperature, the forms or insulation shall be loosened or otherwise vented until the surface temperature is within the specified limits. If the thermometer readings indicate that the minimum required temperature is not being maintained, the structure shall be promptly enclosed and heat furnished as required.
- 3) The insulating material shall be wind and water resistant. Special precautions shall be taken at edges and corners to ensure that such points are adequately protected. The tops of pours shall be protected by a tarpaulin or other approved waterproof cover over the insulation.
- 4) At the close of the protection period, the temperature of the concrete within the form shall be gradually decreased, by loosening the forms of insulation to permit a rate of cooling not to exceed 30°F per 24 hours until the concrete attains atmospheric temperature.

3.10 PLACING CONCRETE UNDER WATER

- a. Placing concrete under water shall be prohibited.

3.11 PROTECTION

- a. All forms and reinforcing steel, located above the concrete being placed and all placing equipment shall be kept clean and free of hardened concrete.
- b. Free Water:
- 1) Concrete for structures shall not be placed in water, nor shall water be allowed to come into contact with freshly poured concrete until it has attained a sufficient set (*except where special prior written permission may have been given to place concrete under water by tremie*).
 - 2) Water used for cleaning the placing equipment shall be discharged outside the forms.
- c. Aluminum Inserts: All aluminum materials inserted in concrete shall have the contact surface coated with bitumastic.

3.12 TIMING OF FORM REMOVAL

- a. No forms shall be removed in less than the time limits specified below or in other applicable sections contained herein, whichever is more stringent.
- b. If forms are loosened less than seven (7) days after the pour, they shall be removed completely, and any required curing procedures started within 1/2 hour after loosening.
- c. The Owner's Representative shall have the right to order the retention of any form until such time, in the Owner's Representative's opinion, they may be safely removed without injury to the structure.
- d. Wall and Column Form Removal
 - 1) Forms for all vertical walls and columns shall remain in place for a minimum of 48 hours after the concrete has been placed, except for periods of cold weather (*where temperature falls below 40°F*), in which case forms shall remain in place for a minimum of 72 hours after concrete has been placed.
- e. Suspended Slab Form Removal
 - 1) Forms for all suspended slabs and suspended beams shall remain in place until all of the following are satisfied.
 - a) Concrete has been in place for a minimum of seven (7) days.
 - b) Test cylinders attain a minimum compressive strength of seventy-five percent (75%) of the 28-day strength specified.
 - 2) For suspended slabs installed in segments, no forms shall be disturbed or removed from under an individual panel or unit until the concrete in the adjacent panel or unit has attained seventy-five percent (75%) of the specified 28-day strength AND has been in place for a minimum of seven (7) days.
 - 3) After form removal, suspended floor slabs, girders and beams shall be shored, in general, for a period of two weeks, under favorable curing conditions.

3.13 TIMING OF BACKFILL INSTALLATION, ETC.

- a. Unless otherwise approved in writing by the Owner's Representative, walls and structures shall not be backfilled until the concrete has reached a minimum of 75% of the specified design strength, but in no case sooner than 3 days after placement of concrete.
- b. If the Contractor proposes to begin backfill operations prior to the standard 7 day cylinder break, additional cylinders shall be cast at the Contractor's expense to allow for additional breaks prior to the standard 7 day time period.
- c. Use of Mechanical Vibration Equipment Adjacent to New Concrete: Unless otherwise approved in writing by the Owner's Representative, use of mechanical vibration equipment adjacent to new (*green*) concrete shall not occur for a minimum of 36 hours after the concrete is placed and finished (*ie. including but not limited to concrete vibrators for additional concrete adjacent to green concrete, vibratory roller compactors adjacent to green concrete, hoe packs or jumping jack compactors, or vibratory*

installation of pilings, caissons or similar components).

3.14 LIQUID LEAKAGE TESTS

- a. All liquid holding structures:
 - 1) Perform leakage tests after concrete has cured and obtained its design strength, and before backfill, brick facing, or other work which will cover concrete wall surfaces is begun.
 - 2) Make other equipment, i.e., stop gates, sluice gates, etc., or temporary bulkheads watertight prior to test.
 - 3) As an alternative to having watertight bulkheads, gates, or valves, accurately measure the leakage through gates, valves and bulkheads with methods acceptable to Construction Manager. An assumed leakage through gates and valves based on manufacturer's recommendations is not acceptable.
 - 4) Fill with water to maximum operating liquid surface prior to leak testing, and maintain level for 48 hours for moisture absorption by concrete.
 - 5) Close all valves and gates to the structure and measure the change in water surface for a 24-hour period.
 - 6) During test period, examine exposed portions of structure for dampness or leaks and mark visible leaks or damp spots.
- b. Test Evaluation Criteria:
 - 1) Drop in water surface in 24-hour period with basin full to the leakage test water level elevations is less than 1/10 of 1 percent of normal volume of liquid contained in water-holding structure, after accounting for evaporation and precipitation in open basins, and damp spots or seepage are not present on walls or other areas exposed to view.
 - 2) Determine evaporation by floating an evaporation pan in structure during test period.
- c. Excessive Leakage and Leakage Test Failure: If drop in water surface exceeds test evaluation criteria or if damp spots or seepage is visible in exposed surfaces.
- d. Repairs:
 - 1) If leakage is excessive, and if damp spots and observed seepage is present on exposed surfaces, drain water-holding structure, epoxy grout inject all cracks, patch all surface areas and damp spots previously marked, and make necessary repairs as outlined hereinbefore and retest basin.
- e. Retest:
 - 1) Refill liquid-holding structure and test for leakage until structure meets test criteria.
 - 2) Successful Test: If liquid level criteria is met and damp spots and seepage problems are corrected.

3.15 REPAIRS

- a. If, for any reason, the finished concrete surfaces show voids, undue roughness or other defects, repairs shall be made or concrete cut out and replaced at the Contractor's expense and in accordance with ACI SPEC-301.
- b. Through holes shall be completely filled by use of a pressure gun.

c. Patching

- 1) Unless otherwise specified, cavities produced by form ties, honeycombed spots, broken corners or edges and other defects shall be cleaned, saturated with water and completely filled, grouted and trued with a mortar of cement and fine aggregate of the same proportions used in the concrete being finished. Form tie holes shall be completely filled by use of a pressure gun or hand ramming method. Defective concrete shall be removed. Small shallow holes caused by air entrapment at the surface of the forms shall not be considered defects unless the amount is so great as to be considered not the standard of the industry and due primarily to poor workmanship.
- 2) On exposed concrete surfaces or walls (*including interior walls of pump station wetwells*), all fins and irregular projections shall be removed with a stone or power grinder or with a bushing hammer, in such a way as to avoid contrasting surface textures and result in a smooth surface.
- 3) If chipping is required to remove rock pockets or other void areas, the edges shall be perpendicular to the surface. Feathered edges for grouted repairs will not be permitted.
- 4) Except where the surface is to be painted or otherwise covered, sufficient white cement shall be substituted for the regular cement in the patching mortar to produce finished patches of the same color as the surrounding concrete (*for concrete which is exposed to view*).
- 5) All defective areas or form tie holes deeper than 2 inches shall be filled with a non-shrink, non-metallic grout. Use an approved bonding agent on horizontal patches prior to placing non-metallic, non-shrink grout. Since some bonding agents may not be compatible for some vertical surface patching techniques, submit all proposed methods for repair of vertical surfaces prior to ordering materials. The Contractor shall consult with representatives of the bonding agent manufacturer and the non-shrink grout manufacturer, and obtain a written recommendation for the patching of defective areas. Submit this information for review prior to performing the work.
- 6) Dress surface of patches that will remain exposed to view to match the color and texture of the adjacent surfaces.

d. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and drypack grout.

e. Repair materials and installation not specified above may be used, subject to Engineer's approval.

PART 4: SPECIAL PROVISIONS

None.

SECTION 03310 GROUTING

PART 1: GENERAL

1.1 SCOPE

- a. This section includes grouting of equipment baseplates or bedplates; column baseplates; other miscellaneous baseplates; and other uses of grout as shown on the drawings.
- b. Unless otherwise specified, all grouting shall be done with non-shrinking grout.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*) as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Non-shrinking grout shall show no shrinkage and a maximum of 4.0% expansion when tested in accordance with ASTM C-827. Non-shrinking grout shall have a minimum initial set time of 60 minutes when tested in accordance with ASTM C-191 and shall have a minimum 28 day compressive strength of 6,000 psi when tested according to ASTM C-109. Non-shrinking grout shall be Master Builders "Masterflow 713 Grout," Five Star Products "Five Star Grout," Sauereisen Cements "F-100 Level Fill Grout," or equal.
- b. Epoxy grout shall have a maximum unrestrained linear shrinkage of 0.001 inches/inch when tested in accordance with ASTM D-2566 and a maximum coefficient of expansion of 27×10^{-6} inches/inch/°F when tested in accordance with ASTM C-531. Epoxy grout shall have a minimum compressive strength of 5,000 psi in 36 hours and 10,000 psi in 7 days when tested according to ASTM C-579, Method B. Epoxy grout shall be U.S. Grout "Five Star Epoxy Grout," Master Builders "Masterflow 648 CP," Unisorb V-100, or equal.
- c. Mixing water shall be clean and free from deleterious substances.

PART 3: EXECUTION

3.1 MIXING

- a. Non-shrinking grout shall be factory premixed so that only water is added at the job site. Nor more water shall be used than is necessary to produce a flowable grout.
- b. Epoxy grout shall be factory supplied in premeasured quantities. The ratio of components shall not be altered nor solvents added to change the grout consistency.

- c. Grout shall be mixed in a mechanical mixer.

3.2 PREPARATION

- a. The existing concrete to receive non-shrinking grout shall be saturated with water for 24 hours prior to grouting.
- b. Concrete surfaces to receive epoxy grout shall be kept completely dry prior to grouting.
- c. New concrete shall be cured a minimum of 7 days before grout placement or until the concrete has attained its design strength.
- d. The concrete shall be entirely free of oil, grease and other deleterious substances. Existing concrete surfaces to receive grout shall be roughened by chipping to sound aggregate to ensure an adequate bond with the grout. New concrete surfaces to receive grout shall be finished rough.
- e. Surfaces from which the grout is to be removed after placing shall be treated according to the manufacturer's instructions.

3.3 PLACEMENT

- a. Grout shall be placed in strict accordance with the directions of the manufacturer. All spaces and cavities below the top of the baseplates and bedplates shall be completely filled without voids. Forms shall be provided where structural components of baseplates or bedplates will not confine the grout.

3.4 FINISHING

- a. In all locations where the grout will be exposed to view, the grout shall be finished smooth after it has reached its initial set.

3.5 CURING

- a. Non-shrink grout shall be protected against rapid loss of moisture by covering with wet rags or polyethylene sheets. After finishing is completed, the grout shall be wet cured for at least 7 days.
- b. Epoxy grout shall be cured in strict accordance with the manufacturer's instructions.

PART 4: SPECIAL PROVISIONS

None.

DIVISION 4

MASONRY

SECTION 04200
CONCRETE MASONRY UNITS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing of all masonry units, reinforcing steel, mortar, insulation, grout, incidentals, installation equipment and labor related to the construction of masonry structures as necessary for the completion of work.
- b. All CMU materials & installation shall fully comply with the MSJC (*Masonry Standards Joint Committee*) Masonry Code & Specifications, as well as Oregon Building Code requirements.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*) as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the following:
 - 1) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item) , including but not limited to the following.
 - a) Reinforcing bar and/or reinforcing wire utilized in reinforced concrete masonry unit products.
 - b) Anchor bolts & Inserts.
 - 2) Manufacturer's information, cut sheets for CMU block, mortar, grout & all accessories proposed for use in CMU walls or structures, as well as certifications showing that the material meets the specifications contained herein.
 - 3) Manufacturer's certification that the block insulation system meets the prescriptive path requirements of the Oregon Energy Efficiency Specialty Code.
 - 4) Anchor bolts & inserts, as specified or shown on the drawings.
 - 5) Color charts and samples showing all available colors shall be provided to review by the Owner's Representative for selection of block colors for use on the project.

- 6) Grout Mix Design.
 - a) Mix design for all grout proposed for use, including a statement regarding the maximum lift height proposed for each specific grout mix submitted.
 - b) Narrative summarizing the maximum grout lift height proposed (which shall not exceed the height between horizontal bond beams), and the size/shape/configuration of any cleanouts provided for grout lifts taller than 5 feet (*including documentation that such cleanouts meet or exceed MSJC recommendations*).
- 7) Samples. After block colors are selected by the Owner's Representative, a minimum of two samples of the CMU block (6" x 6" minimum size) showing texture and color of block or other finished masonry units proposed for use shall be presented for the Owner's Representative's approval.
- 8) Batch Tickets - The grout supplier shall furnish delivery tickets to the Owner's Representative at the unloading site.
- 9) Copies of all quality control, field and laboratory testing required by this section, including slump & compressive strength break results for CMU/grout prisms.

1.3 DELIVERY, HANDLING AND STORAGE

- a. Delivery, handling, and storage shall be in accordance with the requirements of these Contract Documents.

1.4 PROJECT TESTING, LABORATORY SERVICES & QUALITY CONTROL

- a. Quality control/testing services shall be provided by an independent certified laboratory retained by the Owner, and shall be in accordance with the requirements of these Contract Documents. This requirement shall not limit or restrict the concrete supplier from performing his own quality control testing. The testing by the independent laboratory shall include:
 - 1) The laboratory shall make scheduled quality control tests consisting of the following for grout & CMU construction:
 - a) Slump
 - b) Compressive strength per ASTM C476 (Prism method), $F'm = 1500$ psi minimum.
- b. Schedule of Tests:
 - 1) A minimum of two CMU prism/grout test samples shall be prepared in conjunction with the initial pour each day for compressive strength testing (*1 set for testing at 7 days, and 1 set for testing at 28 days*). When grout is placed in the prism samples, slump tests shall be made using grout from the same batch.

PART 2: PRODUCTS

2.1 CONCRETE MASONRY UNITS (CMU)

- a. Color.
 - 1) Colored block shall be furnished to match the color schemes of the existing onsite masonry buildings. Contractor shall provide color charts and samples to verify the color match for the various block colors required for the project.
 - 2) Masonry units used for the building shall match in texture and physical properties those samples approved by the Owner's Representative.
 - 3) Grout for all block shall match the color of the colored block.
- b. Unless otherwise specified or shown on the drawings, all CMU shall be hollow load bearing, fine texture steam cured, lightweight or medium weight block conforming to the requirements of ASTM C-90.
- c. Where shown on the drawings, CMU shall be solid load bearing, fine texture, steam cured, lightweight or medium weight block conforming to the requirements of ASTM C-90.
- d. Concrete Masonry Units shall have a minimum compressive strength of 1500 psi at 28 days. Masonry units at time of placement shall have been air cured for a minimum of 28 days or kiln cured, with maximum water absorption of 17 PCF/Unit and a maximum linear shrinkage of 0.045.
- e. Nominal face dimensions shall be 8" x 16" units. Typical units shall be of the type shown on the drawings. Contractor shall provide any required special shapes. Where not otherwise shown on the drawings, exterior block shall be split face and interior walls shall be smooth.
- f. Block Insulation
 - 1) All CMU in building exterior walls shall be insulated, including non-reinforced grouted cells.
 - 2) Block insulation shall be expandable polystyrene block inserts individually molded to have a minimum density of 1.0 P.C.F., and shall conform to ASTM C578 Standard Type 1. Insulation shall be KORFIL Block Insulation as produced by Concrete Block Insulating Systems, Inc. or approved equal.
 - 3) Factory Install Block Insulation. Block inserts shall be installed in the cores of blocks at the block producer's plant so that only blocks with inserts already installed are delivered to the job site. Inserts shall be properly installed in accordance with manufacturer's specifications to allow blocks to be handled or saw cut without danger of insert dislodgment.
 - 4) No Insulation for Bond Beam Block. Block insulation shall be removed from bond beam cells containing rebar (*horizontal & vertical bond beams*) as required to ensure that reinforcing bar is totally encased with grout.
 - 5) Blocks containing damaged or mutilated inserts will not be accepted, and shall be removed from the jobsite.

2.2 REINFORCING STEEL

- a. Bar reinforcement shall be Grade 60 deformed bars meeting the requirements of ASTM A-615 or ASTM A-706 for welded connections.
- b. Except where shown otherwise on the drawings, masonry walls shall be reinforced as follows:
 - 1) For 8" walls
 - a) #5 vertical at 40 inches on center at centerline of wall
 - b) (2) #4 horizontal continuous at 48 inches on center.
 - c) #4 corner bars (24" x 24") at all interior and exterior wall intersections (*alternate hook directions at T wall intersections*).

2.3 MORTAR

- a. Mortar shall conform to ASTM C270, Type M or type S.
- b. Mortar for special use shall follow the same specifications and use coloring added to the mortar, as required to match the block color. Unless otherwise specified, this requirement shall not apply to block scheduled to be painted on both sides with other than a clear coating.
- c. Mortar for underground use shall conform to ASTM C270, Type S, but shall not contain masonry cement.

d. Mortar Proportions by Volume

Mortar Type	Portland Cement	Masonry Cement	Hydrated Lime or Lime Putty	Aggregate (Damp, Loose)
M	1	1	0	Not less than 2¼ and not more than 3 times the sum of cement and lime.
S	1	0	¼ to ½	

- e. Materials shall be proportioned by measuring the ingredients and thoroughly mixing in a portable drum type mortar mixer or approved other method. Mixing shall continue until the mortar is uniform in color and consistency.
- f. Only sufficient mortar shall be prepared for immediate use, and any mortar that has set shall not be retempered or used in the work.
- g. Setting accelerators or antifreeze compounds shall not be used.
- h. Masonry cement shall conform to ASTM C91, Type II, and shall be a product of the Huron Portland Cement Co., North American Cement Corp., or equal.
- i. Mortar shall be mixed with sand of the type and gradation recommended by the cement manufacturer in proportion to volume of one part cement to three parts sand.

2.4 GROUT

- a. Unless otherwise specifically shown on the drawings, grout fill all cells in all masonry units (*maximum grout lift heights shall be as specified in Part 3*).

- b. Grout for reinforced masonry walls shall be ready-mix grout conforming to ASTM C-476, 2500 psi minimum at 28 days.
 - 1) Submit copy of grout mix design to the engineer prior to grout placement.
 - 2) Water/cement ratio shall not exceed 0.56. No grout aggregate shall exceed 3/8" in size.
 - 3) Grout Slump.
 - a) Grout slump shall be 8", ±1" for grout lift heights up to a maximum of 5 feet.
 - b) If grout placement lifts greater than 5 feet in height are proposed, grout slump shall be a minimum of 10" (10" to 11" slump).

2.5 BOND BEAMS

- a. Provide knockout bond beam block for all horizontal bond beams and at the tops of each wall.
- b. Bond beams shall consist of load bearing units filled with concrete or grout and reinforced as specified herein or indicated on the drawings.
 - 1) The reinforcement shall be continuous except through expansion joints.
 - 2) Where the bond beam is not broken at the expansion joint, a false control joint shall be formed in the bond beam.
- c. Provide corner bars same size and spacing as horizontal bars and projecting 40 bar diameters each way.
- d. Unless otherwise shown on the drawings, the location of the bond beams around openings shall be as outlined below. Extend lintels and associated bars not less than 24-inches past the edge of each opening.
 - 1) For openings 4 feet wide or less, provide 8" lintel bond beam with one #5 bar above and below the opening, as well as one additional full height #5 bar on each side of the opening.
 - 2) For openings greater than 4 feet but less than 8 feet wide, provide 16" bond beam with two #5 bars above and below the opening, as well as one additional full height #5 bar on each side of the opening.

2.6 VERTICAL CONTROL JOINTS, JOINT/GAP SEALING

- a. Vertical Control Joints. Control joints in CMU block walls shall be made with VS Series PVC Control Joint (size to fit wall thickness) by Hohmann & Barnard (Dur-O-Wal) or approved equal.

Vertical control joints in CMU walls shall be placed at a maximum horizontal spacing as specified in Part 3 or noted on the drawings, with any vertical control joint to be located at or beyond the end of lintels over doors, windows, louver openings, etc.

- b. Backer Rod. Backer rod for control joints and other construction joints/gaps in CMU block walls (*including but not limited to gaps around louver openings, etc.*) shall be soft bi-cellular polyethylene backer rod for use in building envelope & concrete construction, designed such that it will not out-gas if skin is ruptured, SOF ROD by Nomaco or approved equal.

Rod shall typically be oversized (25-50%) to fit tightly into the joint, and shall function as a bond breaker to prevent back-side adhesion of the sealant.

c. CMU Control Joint & Construction Joint/Gap Sealant.

- 1) Sealant for use over backer rod for control joints and other gaps in CMU block walls (*including but not limited to gaps around louver openings, etc.*) shall be a ultra-low modulus sealant specifically designed for new and remedial construction joint sealing applications, Dowsil 790 Silicon Building Sealant or approved equal.
- 2) Sealant Color. For interior or exterior surfaces which will be painted, the sealant shall be provided in the color which most closely matches the paint finish coat color (*since most paint films will not adhere to the sealant and typically will not stretch with the sealant, and so will crack & peel*). Color selection to be confirmed with the Owner's Representative.

Where clear CMU block sealer is utilized, the sealant shall be provided in the color which most closely matches the CMU block or mortar color (*color selection to be confirmed with the Owner's Representative*).

- d. Any sealant used for interior penetrations which are part of a firestop sealing system shall be specifically rated for such use.

2.7 ANCHOR BOLTS FOR EQUIPMENT MOUNTING TO CMU WALLS

- a. Anchor bolts may only be installed in CMU walls that are solid grouted.
- b. Unless otherwise specified or shown on the drawings, connections to masonry structures shall be made using approved 304 stainless steel expansion anchors in predrilled holes.
- c. For equipment mounted to CMU walls with expansion anchors, seismic anchor calculations shall be provided by a licensed structural engineer (*retained by the Contractor or the equipment supplier*), for the specific equipment being mounted. The specific size, length & style of anchor bolts (*304 stainless steel*) to be used shall be listed with the calculations.
- d. Anchor bolts for mounting equipment on CMU walls shall be long enough to be fully embedded in the solid grouting in the CMU cells, accounting for any insulation inserts (5" minimum embed typically required for standard 8" CMU walls).
- e. Any drills used for anchor bolt holes drilled in CMU walls shall have a positive depth stop mechanism in order to prevent accidental through drilling.

PART 3: EXECUTION

3.1 GENERAL

- a. All masonry construction shall conform with present OSHA requirements including those regarding the establishment of "limited access zones".

- b. All masonry construction shall be in accordance with the current edition of ACI 530.1 “Specification for Concrete Masonry Construction” and transporting of ready-mix grout in accordance with ASTM C94 “Standard Specifications for Ready-Mix Concrete”.
- c. Units shall be laid in a full bed of mortar. Masonry units shall be placed in courses of running bond.
- d. Courses shall be carried up level with no section of wall extended more than 3 feet above an adjacent section. When specifically permitted or required, in certain locations, courses shall be stepped as directed.
- e. All CMU shall be set such that the smooth face of split face block and both faces of standard block form a smooth and uniform wall surface without offsets. Interior and exterior joints shall be finished concave, unless otherwise ordered.
- f. Window and door frames shall be set plumb and true, and securely braced, and joints between brick and frames thoroughly filled. Sills, lintels, bearing plates, etc., shall be set in full bed of mortar.
- g. Block Orientation & Bond Joint Pattern.
 - 1) Block shall be set with cells vertical, with running bond joints (*ie. offset vertical joints*) between successive CMU courses.
 - 2) Block shall also be set in running bond pattern at all intersections, and bonded or keyed with wall ties (*24” long corner bars matching horizontal wall reinforcing*).
- h. Double Top Bond Beam. Unless otherwise shown on the drawings, a reinforced double bond beam (*2 cell height*) shall be provided under all roof or beam loads.
- i. Lintel Beams. Lintels shall be provided over all openings of width greater than the length of a masonry unit. Lintels shall be of the type and length indicated on the drawings or as required, and shall be acceptable to the Owner’s Representative.
 - 1) Lintel Length Beyond Opening. Lintels shall extend at least 24-inches beyond each side of the opening unless longer lengths are indicated on the drawings.
- j. Expansion joints, control joints, masonry flashing, flue liners and other specialties shall be accurately installed as detailed on the drawings. Unless otherwise shown on the drawings, control joints shall be isolated by a 1/4-inch thick PVC keyed gasket as specified.
 - 1) Control Joint Spacing. Unless otherwise shown on the drawings or details, or otherwise directed by the Owner’s Representative, vertical control joints in CMU walls shall be placed at a maximum horizontal spacing of 25 feet, with any vertical control joint to be located a minimum of 24-inches from any opening in the CMU wall (*ie. shall be at or beyond the end of lintels over doors, windows, louver openings, etc.*).

3.2 GROUT POUR & GROUT LIFT HEIGHT LIMITS/REQUIREMENTS

- a. A grout pour is the entire height of masonry, to be grouted, before more courses of masonry are constructed. A grout lift is the amount of grout placed in a single continuous operation, with sufficient time for the previous grout placement to cure for a minimum of 24 hours.

- b. The MSJC Masonry Code and Specifications, Building Code Requirements and Specifications for Masonry Structures and Commentaries (TMS 402/ACI 530/ASCE 5, TMS 602/ACI 530.1/ASCE 6), spells out recommended CMU grouting practices, including requirements for allowable grout lift heights and grout pours.
- c. If there are reinforced horizontal bond beams present within the CMU wall, the maximum allowable grout lift height is limited to the height between each respective horizontal bond beam in all cases. The failure by the Contractor to account for the number of grout pours necessary to meet this requirement shall not entitle the Contractor to additional contract time or additional compensation.
- d. MSJC provisions & recommendations regarding grout lift heights shall be followed, with grout lifts not exceeding 5 feet unless all of the following conditions are met (*ie. high lift grout placement is only allowed if all of the following conditions are met, and if the high lift grout placement is approved in writing by the Owner's Representative a minimum of 5 days prior to the grout placement*).
 - 1) All masonry mortar in the segments being filled has cured for an absolute minimum of four hours (*longer cure times are recommended*).
 - 2) The grout has a slump of 10 to 11 inches.
 - 3) There are no intermediate horizontal reinforced bond beams between the top and bottom of the grout pour height.

Even if all of the conditions above are met, the grout lift heights shall not exceed 12.67 feet (*12 feet 8 inches*).
- e. Regardless of other conditions, if the masonry has not cured for at least four hours before grouting or if the grout has a slump less than 10 inches, grout lifts cannot exceed a maximum of five (5) feet or the height between horizontal reinforced bond beams, whichever is less.
- f. Cleanouts (*per Masonry Standards Joint Committee (ACI) standards/recommendations*) are required in the bottom course for each grout pour with a lift height greater than five (5) feet.

3.3 RECESSES AND WALLING-IN WORK

- a. The Contractor shall attend to walling in at their proper position all steel beams, steel columns, bar joists, lintels, window and door frames, anchors, anchor bolts, cutout boxes, electric conduits, downspouts, pipe sleeves and all similar work, and shall form all flues, ventilating shafts, leader shafts, recesses, and openings in the walls for the complete performance of the other work of the Contract.
- b. All aluminum materials inserted in masonry shall have the contact surface coated with bitumastic.

3.4 BACKER ROD & SEALANT INSTALLATION (Control Joints & Wall Penetrations)

- a. Backer rod & sealants shall be installed in strict conformance with manufacturer recommendations.
- b. Prior to installing backer rod, joints should be cleaned per the sealant manufacturer's recommendations. Thoroughly remove any concrete form-release agents, curing

compound residue, laitance, efflorescence or any foreign materials. Install backer rod with a blunt tool at the depth recommended by the sealant manufacturer.

Care should be taken not to over-compress or stretch SOF Rod during installation. Proper size selection is important as it controls the depth of the sealant bead. It must be oversized (25-50%) to fit tightly into the joint and function as a bond-breaker to prevent back-side adhesion of the sealant.

- c. To ensure a good sealant bond, joints must be clean and dry when the new sealant is installed. Air compressors used for this purpose must be equipped with traps for removal of oil and moisture.

3.5 COLD WEATHER PLACEMENT AND PROTECTION

- a. No block shall be laid in weather below 40°F except by written permission of the Owner's Representative. When such permission is granted block laying shall be in accordance with the recommendations of the International Masonry Industry All Weather Council except as modified herein.
- b. Masonry units and mortar shall be sufficiently preconditioned with warm water to obtain a mortar temperature of 60°F when laid.
- c. The mixing water shall be between 130°F and 165°F.
- d. The completed masonry shall be protected from rain or snow for a period of 24 hours by non-staining weather resistive membrane and protected from freezing by use of insulating blankets and auxiliary heat as recommended by the International Masonry Industry All Weather Council.
- e. The tops of masonry walls shall be protected with covers during the night, inclement weather, or delays during construction.
- f. Uniform or concentrated loads shall not be applied to newly laid masonry walls or columns for at least three days.
- g. Backfill: Unless otherwise approved in writing by the Owner's Representative, walls and structures shall not be backfilled until the grout has reached a minimum of 75% of the specified design strength, but no sooner than 7 days after placement of grout.

3.6 HOT WEATHER PROTECTION

- a. During hot weather, masonry units shall be wet down periodically with enough water to prevent rapid absorption of moisture from the mortar when laid.
- b. Finished work shall be protected from winds and sun by wet covers for a period of 24 hours.

3.7 CMU BLOCK CLEANING

- a. After completion of masonry work and soon prior to installing paint, sealant or coatings, all CMU surfaces shall be thoroughly cleaned using dilute muriatic acid or equivalent, while exercising extreme care to prevent acid or corrosive cleaners from contacting concrete work, cut stone, metal or doors.

PART 4: SPECIAL PROVISIONS
None.

DIVISION 5

METALS

**SECTION 05500
METAL FABRICATIONS**

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

- a. This Section includes the following:
 - 1) Miscellaneous steel and aluminum framing and supports and bearing plates.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*) as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include, but not be limited to, the following:
 - 1) Submittals for Review. Submittals shall include but not limited to the following. Approval of submittals by the Owner's Representative shall be obtained prior to ordering materials and/or equipment associated with the bypass pump system.
 - a) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item)..
 - b) Shop Drawings: Include plans, elevations, sections, details of installation, and attachments to other Work.
 - c) Templates: For anchor bolts.
 - d) Anchor Bolts for Equipment.
 - (1) Complete specifications, descriptive drawings, and literature for the anchor bolts recommended/required for the equipment being provided (*including bolt size, material, embedment depth, drill hole size, and type of epoxy for use for epoxy set bolts*).
 - (2) Where approved by the Owner's Representative, epoxy anchor bolts may be proposed at the option of the Contractor, subject to the embedment depth being equal or greater to the standard anchor bolt depth shown or specified, and subject to epoxy anchor bolt specification requirements below.

Where specified or required by the Owner's Representative for critical equipment anchorage, the supplier or Contractor shall

provide calculations by an Oregon structural engineer showing that the proposed anchor bolt system meets seismic standards for the proposed equipment & use.

- 2) Contractor shall allow sufficient lead time to permit detailing, submission, and review of placing drawings, fabrication, and delivery of members to be accomplished within the framework of the established construction schedule.
- 3) Contractor shall thoroughly review and redline all shop drawings prior to submittal to the design team.

PART 2: PRODUCTS

2.1 METALS

- a. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.
- b. Ferrous Metals:
 - 1) Steel Wide Flange: ASTM A-992, 50 KSI minimum yield strength.
 - 2) Other Shapes, Steel Plates, and Bars: ASTM A-36, 36 KSI minimum yield strength.
 - 3) Stainless-Steel Bars and Shapes: ASTM A-276, Type 316L, 25 KSI minimum yield strength, except where Type 304 is noted or specified.
 - 4) Steel Tubing: Cold-formed steel tubing complying with ASTM A-500, 46 KSI minimum yield strength.
 - 5) Steel Pipe: ASTM A-53, 35 KSI minimum yield strength, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- c. Aluminum:
 - 1) Extrusions: ASTM B-221, alloy 6063-T6.
 - 2) Alloy Rolled Tread Plate (Checkered Plate): ASTM B-632, alloy 6061-T6.
 - 3) Shapes, Bars and Plates: ASTM B-221, alloy 6061-T6.

2.2 PAINT

- a. Shop Primer for Ferrous Metal: See Division 9, Section 09900 "Painting."
- b. Galvanizing Repair Paint: SSPC-Paint 20, high-zinc-dust-content paint for re-galvanizing welds in steel.

2.3 MISCELLANEOUS MATERIALS

- a. Fasteners: Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B-633, Class Fe/Zn 5, where built into exterior walls, of type, grade, and class required by application indicated.
- b. Non-shrink, Nonmetallic Grout: ASTM C-1107, factory-packaged, non-staining, noncorrosive, nongaseous grout.

2.4 FABRICATION

- a. Connections, General: Use connections that maintain structural value of joined pieces.
 - 1) Shear and punch metals cleanly and accurately. Remove burrs.
 - 2) Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.
 - 3) Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes.
 - 4) Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
- b. Miscellaneous Framing and Supports: Fabricate steel and aluminum framing and supports as necessary to complete the Work as shown on Drawings. Cut, drill, and tap units to receive hardware, hangers, and similar items.
- c. Miscellaneous Steel Trim: Fabricate units with continuously welded joints and smooth exposed edges. Miter corners and use concealed splices where possible. Fabricate cutouts, fittings, and anchorages; coordinate assembly and installation with other work.

2.5 FINISHES

- a. Finish metal fabrications after assembly. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Shop prime ferrous-metal items not indicated to be galvanized.
 - 1) Hot-dip galvanize items indicated to be galvanized to comply with ASTM A-123 or ASTM A-153/A-153M as applicable.
 - 2) Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
 - 3) Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

- 4) All stainless steel parts & equipment shall be chemically passivated per ASTM A380 - Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.

2.6 ANCHOR BOLTS FOR EQUIPMENT BASES

- a. All anchor bolts for equipment bases shall be 304 stainless steel.
- b. The diameter, length and any bend dimensions of anchors shall be as shown on the drawings or as recommended by the equipment or machinery manufacturer, whichever is more stringent or more accurate. Sleeves shall be provided as required or as shown for location adjustment.
- c. Unless otherwise required or shown, use 3/4 inch minimum diameter and other geometry as shown on the drawings. In no case shall anchor bolts be more than 1/8-inch smaller than the anchor bolt holes provided by the manufacturer in the equipment or machinery.
- d. Epoxy Threaded Anchor Rod Option. If drilled & epoxied threaded anchor rods are proposed by the Contractor or the equipment supplier in place of standard cast-in-place anchor bolts, the size and embed depth of the stainless steel threaded rods shall meet or exceed the size and embed depth of the standard anchor bolts recommended/required by the manufacturer (*or shown on the drawings*), for the specific equipment being provided, and based on the following.
 - 1) Epoxy adhesive for use with the 304 stainless steel threaded anchor rods shall be Simpson SET-3G High-Strength Epoxy Adhesive.
 - 2) The size of the hole in the concrete shall be in conformance with the manufacturer's recommendations (*typically 1/8" larger than the threaded rod diameter*).
 - 3) Installation shall fully conform with the manufacturer's recommendations, including hole cleaning & epoxy installation.
 - 4) Contractor shall be responsible for coordinating all inspections and special inspections required for such drilled & epoxied threaded anchor rods by applicable building codes.
 - 5) Contractor shall ensure that anchor bolts are not disturbed until epoxy is fully cured (*see SET-3G cure schedule, typically varies from 24 to 72 hours, depending on concrete temperature*), by either do not allowing entry into the anchor bolt area for the entire cure time, OR providing secure anchored covers over the anchor bolts to ensure that they are not accidentally disturbed.
- e. If anchor bolt configurations are proposed which are different from the manufacturer's cast-in-place recommendations, or are based on a different drilled & epoxied option than listed above, calculations shall be provided (*by a licensed structural engineer retained by the pump supplier or Contractor*) showing that the proposed anchor bolt system is structurally equivalent to the standard cast-in-place anchor bolts recommended/required by the manufacturer (*or shown on the drawings*), for the specific equipment being provided.
- f. A minimum of two nuts and one washer, of the same material as the bolt, shall be furnished with each bolt, with both nuts being fully engaged on the anchor bolt threads.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General: Provide anchorage devices and fasteners for securing metal fabrications to in-place construction. Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true.
 - 1) Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
 - 2) Fit exposed connections accurately together. Weld connections, unless otherwise indicated. Do not weld, cut, or abrade galvanized surfaces.
 - 3) Deliver steel bearing plates and other items to be built into other work so as not to delay the other work.
- b. Touch up surfaces and finishes after erection.
 - 1) Painted Surfaces: Clean field welds, bolted connections, and abraded areas and touch up paint with the same material as used for shop painting.
 - 2) Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A-780.
- c. Aluminum fabrications shall be bolted with hot dipped galvanized or stainless steel bolts where bolts are required.
 - 1) Martensitic stainless steel (Type 410) shall not be used for aluminum connections.
 - 2) Austenitic stainless steel (Type 302/304, 303, 305) shall be used for aluminum connections.

PART 4: SPECIAL PROVISIONS

None.

SECTION 05521
ALUMINUM PIPE AND TUBE RAILINGS

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

- a. This Section includes the following:
 - 1) Aluminum pipe and tube railings.
- b. All work performed under this section shall be in accordance with all approved trade practices and manufacturers' recommendations, including provisions for insulation between dissimilar metals where applicable.

1.2 PERFORMANCE REQUIREMENTS

- a. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1) Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
- b. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1) Handrails:
 - a) Uniform load of 50 lbf/ ft. applied in any direction.
 - b) Concentrated load of 200 lbf applied in any direction.
 - c) Uniform and concentrated loads need not be assumed to act concurrently.
 - 2) Rails of Guards:
 - a) Uniform load of 50 lbf/ ft. applied in any direction.
 - b) Concentrated load of 200 lbf applied in any direction.
 - c) Uniform and concentrated loads need not be assumed to act concurrently.
- c. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1) Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- d. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.3 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*) as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include, but not be limited to, the following:
 - 1) Product Data: For the following:
 - a) Manufacturer's product lines of mechanically connected railings.
 - b) Grout, anchoring cement, and paint products.
 - 2) Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - a) For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - b) Contractor shall thoroughly review and redline all shop drawings prior to submittal to the design team.
 - 3) Samples for Verification: For each type of exposed finish required.
 - a) Sections of each distinctly different linear railing member, including handrails, guard rails and posts.
 - b) Fittings and brackets.
 - c) Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - d) Show method of connecting members at intersections.
 - 4) Mill Certificates: Signed by manufacturers of aluminum products certifying that products furnished comply with requirements.
 - 5) Welding certificates.
 - 6) Qualification Data: For professional engineer and testing agency.
 - 7) Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E-894 and ASTM E-935.

1.4 QUALITY ASSURANCE

- a. Source Limitations: Obtain each type of railing through one source from a single manufacturer.
- b. Welding: Qualify procedures and personnel according to the following:

- 1) AWS D1.2, "Structural Welding Code--Aluminum."

1.5 PROJECT CONDITIONS

- a. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1) Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2) Provide allowance for trimming and fitting at site.

1.6 COORDINATION AND SCHEDULING

- a. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- b. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

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:
 - 1) Aluminum Pipe and Tube Railings:
 - a) AlumaGuard Corp.
 - b) Golden Railings, Inc.
 - c) Superior Aluminum Products, Inc.

2.2 METALS, GENERAL

- a. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- b. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.3 ALUMINUM

- a. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

- b. Extruded Bars and Tubing: ASTM B-221, Alloy 6063-T5/T52.
- c. Extruded Structural Pipe and Round Tubing: ASTM B-429, Alloy 6063-T6.
 - 1) Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.
- d. Drawn Seamless Tubing: ASTM B-210, Alloy 6063-T832.
- e. Plate and Sheet: ASTM B-209, Alloy 6061-T6.
- f. Die and Hand Forgings: ASTM B-247, Alloy 6061-T6.
- g. Castings: ASTM B-26, Alloy A356.0-T6.

2.4 WELDING MATERIALS, FASTENERS, AND ANCHORS

- a. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- b. Fasteners for Anchoring Handrails and Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring handrails and railings to other types of construction indicated and capable of withstanding design loads.
 - 1) For aluminum handrails and railings, use fasteners fabricated from stainless steel Types 302/304, 303, 305 or hot dipped galvanized steel.
- c. Fasteners for Interconnecting Handrail and Railing Components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
 - 1) Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for handrails and railings indicated.
 - 2) Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
- d. Cast-in-Place and Post-Installed Anchors: Anchors of type indicated below, shall be per Section 03200, Part 2.3 c Anchor Bolts and Inserts.
 - 1) Cast-in-place anchors.
 - 2) Adhesive anchors.
 - 3) Expansion anchors.

2.5 GROUT AND ANCHORING CEMENT

- a. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended

by manufacturer for interior and exterior applications.

2.6 FABRICATION

- a. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- b. Assemble handrails and railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- c. Form changes in direction of railing members as follows:
 - 1) By bending.
- d. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- e. Welded Connections: Fabricate handrails and railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections continuously to comply with the following:
 - 1) Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2) Obtain fusion without undercut or overlap.
 - 3) Remove flux immediately.
 - 4) At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- f. Nonwelded Connections: Fabricate handrails and railings by connecting members with concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- g. Welded Connections for Aluminum Pipe: Fabricate pipe handrails and railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- h. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.
- i. Provide inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.

- j. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.
- k. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- l. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.
- m. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.
- n. Fabricate joints that will be exposed to weather in a watertight manner.
- o. Close exposed ends of handrail and railing members with prefabricated end fittings.
- p. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is 1/4 inch or less.
- q. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 FINISHES, GENERAL

- a. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- b. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.8 ALUMINUM FINISHES

- a. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
- b. Mechanical Finish: AA-M12 (Mechanical Finish: nonspecular as fabricated).
- c. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

PART 3: EXECUTION

3.1 INSTALLATION, GENERAL

- a. Fit exposed connections together to form tight, hairline joints.
- b. Perform cutting, drilling, and fitting required to install handrails and railings. Set handrails and railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.

- 1) Do not weld, cut, or abrade surfaces of handrail and railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2) Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3) Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- c. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.
 - d. Adjust handrails and railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.
 - e. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- a. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of handrails and railings.
- b. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- c. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.3 ANCHORING POSTS

- a. Anchor posts to metal surfaces of metal supporting members as follows:
 - 1) For aluminum pipe railings, attach posts as indicated using fittings designed and engineered for this purpose.

3.4 ANCHORING RAILING ENDS

- a. Anchor railing ends into concrete and masonry with round flanges connected to railing ends and anchored into wall construction with post-installed anchors and bolts.
- b. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces.
 - 1) Weld flanges to railing ends.

3.5 ATTACHING HANDRAILS TO WALLS

- a. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
- b. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- c. Secure wall brackets to building construction as follows:
 - 1) For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

3.6 CLEANING

- a. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

3.7 PROTECTION

- a. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.
- b. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

PART 4: SPECIAL PROVISIONS

None.

**SECTION 05530
ALUMINUM GRATINGS**

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

- a. This Section includes the following:
 - 1) Metal bar gratings.
 - 2) Metal frames and supports for gratings.
- b. All work performed under this section shall be in accordance with all approved trade practices and manufacturers' recommendations, including provisions for insulation between dissimilar metals where applicable.

1.2 PERFORMANCE REQUIREMENTS

- a. Structural Performance of Gratings: Provide gratings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1) Floors: Uniform load of 100 lbf/sq. ft. or concentrated load of 300 lbf, whichever produces the greater stress.
 - 2) Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft.
 - 3) Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. or concentrated load of 8000 lbf, whichever produces the greater stress.
 - 4) Limit deflection to L/180 or 1/4 inch, whichever is less.

1.3 SUBMITTALS

- a. Submittals shall conform to the requirements of these Contract Documents and shall include:
 - 1) Product Data: For the following:
 - a) Metal bar gratings.
 - b) Clips and anchorage devices for gratings.
 - c) Paint products.
 - 2) Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - a) Provide templates for anchors and bolts specified for installation under other Sections.
 - b) For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- 3) Contractor shall thoroughly review and redline all shop drawings prior to submittal to the design team.
- 4) Welding certificates.
- 5) Qualification Data: For professional engineer.

1.4 QUALITY ASSURANCE

- a. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual."
- b. Welding: Qualify procedures and personnel according to the following:
 - 1) AWS D1.2, "Structural Welding Code--Aluminum."
 - 2) AWS D1.6, "Structural Welding Code--Stainless Steel."

1.5 PROJECT CONDITIONS

- a. Field Measurements: Verify actual locations of walls, operator stems, sensors, pipe penetrations, and other construction contiguous with gratings by field measurements before shop drawings and fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

- a. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2: PRODUCTS

2.1 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:
 - 1) Metal Bar Gratings:
 - a) Grating Pacific, LLC.
 - b) IKG Industries; a Harsco Company.
 - c) Ohio Gratings, Inc.

2.2 ALUMINUM

- a. Aluminum, General: Provide alloy and temper recommended by aluminum producer for type of use indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- b. Extruded Bars and Shapes: ASTM B-221, alloys as follows:
 - 1) 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.

- 2) 6061-T1, for grating crossbars.

2.3 FASTENERS

- a. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners. Select fasteners for type, grade, and class required.
- b. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F-593 for bolts and ASTM F-594 for nuts, Alloy Group 2.
- c. Anchors: Provide cast-in-place or adhesive anchors per Section 03300, Part 2.3 c Anchor Bolts and Inserts.
 - 1) Material for Anchors: Alloy Group 2 stainless-steel bolts complying with ASTM F-593 and nuts complying with ASTM F-594.

2.4 MISCELLANEOUS MATERIALS

- a. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.
- b. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D-1187.

2.5 FABRICATION

- a. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- b. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- c. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- d. Fit exposed connections accurately together to form hairline joints.
- e. Welding: Comply with AWS recommendations and the following:
 - 1) Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2) Obtain fusion without undercut or overlap.
 - 3) Remove welding flux immediately.
- f. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

2.6 METAL BAR GRATINGS

- a. Pressure-Locked, Rectangular Bar Aluminum Grating: Fabricated by swaging crossbars between bearing bars.
 - 1) Grating Mark A-19-4 Aluminum: Bearing bars at 1-3/16 inches o.c. and crossbars at 4 inches o.c. depth as indicated.
 - 2) Traffic Surface: Serrated bearing bars or applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive per plans.
 - 3) Aluminum Finish: Mill finish.
- b. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
 - 1) Provide not less than 4 saddle clips for each grating section composed of rectangular bearing bars 1/4 inch or less in thickness and spaced 15/16 inch or more o.c., with each clip designed and fabricated to fit over 2 bearing bars.
- c. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
 - 1) Edge-band openings in grating that interrupt bearing bars with bars of same thickness and material as bearing bars, per Drawings.
- d. Do not notch bearing bars at supports to maintain elevation.
- e. All gratings shall be furnished with a serrated surface for improved traction.

2.7 GRATING FRAMES AND SUPPORTS

- a. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
 - 1) Unless otherwise indicated, fabricate from aluminum.
 - 2) Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated on the Drawings, space anchors 24 inches o.c. and provide minimum anchor units in the form of straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

PART 3: EXECUTION

3.1 INSTALLATION, GENERAL

- a. Fastening to In-Place Construction: Provide anchorage devices and fasteners where

necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

- b. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- c. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- d. Fit exposed connections accurately together to form hairline joints.
- e. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING METAL BAR GRATINGS

- a. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- b. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- c. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

PART 4: SPECIAL PROVISIONS

None.

DIVISION 6

WOOD AND PLASTICS

SECTION 06100
ROUGH CARPENTRY

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing all rough carpentry work required to complete the work.
- b. This section includes, but is not limited to, the following:
 - 1) Blocking, nailing strips, cant strips, furring and miscellaneous formwork as required.
 - 2) Grounds on masonry to be secured with wood nailing blocks or wood plugs. Grounds on metal lath furring to be wired to metal lath furring channels.
 - 3) Temporary doors at outside door openings including padlocks and hasps.
 - 4) Rough hardware consisting of nails, screws, bolts, etc., as required to complete all items of rough carpentry work.
 - 5) Temporary weather protection as required.
 - 6) Protection of all projecting masonry and tile corners.
 - 7) Wood dock bumpers, wood baffles and wood mounting panels.
 - 8) Built-up roof curbs, cants and nailers.
 - 9) Application of preservative to treated wood that has been cut, bored, sawed, dressed or otherwise altered during preparation for installation.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*) as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of Section 01300 and shall include for review purposes:
 - 1) Lumber suppliers' warranty that the specified kind and grade of lumber has been furnished.
 - 2) Statements showing the timber has had the preservative treatment specified.
 - 3) Two samples of each type of rough hardware proposed.

1.3 WORKMANSHIP

- a. All work performed shall comply with and be in accordance with approved trade practices and manufacturers' recommendations.
- b. The work shall be performed by skilled tradesmen who are experienced in this type of construction.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Where shown on the drawings or required, the materials for rough carpentry shall conform to the following Specifications where applicable.
- b. Lumber stock for rough carpentry shall be well seasoned, having a moisture content of not more than 18%.
- c. Grounds, nailing strips, etc., shall be #2 Eastern Spruce, Hemlock or Douglas Fir or #3 common yellow pine.
- d. Blocking, furring, dimension lumber, etc., shall be #1 dimension, Douglas Fir, Eastern Spruce or Hemlock of thickness shown.
- e. Exterior plywood shall be Douglas Fir or other approved species selected for the use, of sound grade, 5ply lumber core of the thickness called for on the drawings, and constructed to the Specifications for exterior grade.
- f. All wood exposed to the weather and all wood in exterior walls that is in contact with masonry or steel shall be pressure treated and impregnated in strict accordance with recommended practice of the American Wood Preservers Institute LP2 and Federal Specifications TTW550 and TTW571.
- g. Wood cant strips, wood nailers and blocking, stop planks and other lumber in contact with roof decks, masonry or concrete shall be fabricated from wood having had preservative treatment similar to "Osmose" pressure method, Federal Specifications TTW571 and TTW550.
- h. Surfaces of treated wood which have been cut, bored, sawed, dressed or otherwise disturbed shall be given at least three heavy brush coats of preservative of at least 10 strength, applied hot, thoroughly brushed in and completely saturating surface.
- i. Rough hardware which is exposed to the weather or installed in locations of humid atmosphere shall be galvanized or cadmium plated.
- j. All surfaces of lumber which will be in contact with masonry or concrete shall be back primed with bitumastic before erection.

PART 3: EXECUTION

3.1 GENERAL

- a. Unless otherwise noted on the Contract drawings, wood nailers shall be secured to concrete, masonry, or steel supports with 1/2inch diameter bolts spaced not more than 2 feet 0-inches on centers. No piece of wood shall be secured with less than two bolts. Provide washers under all bolt heads and nuts. The bolt heads and/or nuts shall be countersunk.
- b. Grounds for all purposes shall be strongly secured. They shall be 5/8 inch thick, and placed for all trim, and shall be at least 1¾ inches wide wherever possible. Grounds shall be fir or spruce, free from loose knots or sappy spots, secured by nails, wire (16 gauge), or toggle bolts as required.
- c. Assist the other trades in laying out and placing anchors, clips and supports.
- d. Provide cutting and carpentry work required for building in work of other trades.
- e. Brace, plumb, and level members and secure with sufficient nails, spikes and bolts to ensure rigidity.
- f. Provide and install all bolts set into concrete or masonry for attachment of plates, blocking and other items of carpentry and millwork.
- g. Perform all cutting of wood members that becomes necessary for the installation of mechanical equipment, such as thermostats, electric outlets, piping, etc. Fit woodwork around equipment, etc.

PART 4: SPECIAL PROVISIONS

None.

SECTION 06200
FRAMING AND FINISH CARPENTRY

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing all materials, installation equipment and labor related to the construction of the applicable portions of all buildings and appurtenances as shown on the drawings and as required to complete the work.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*) as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) A sample of each type of finished wood and/or laminated plastic surface.
 - 2) Manufacturer's literature or samples of finish hardware.
 - 3) A schedule of where each type of material will be used.
 - 4) Trusses:
 - a) Shop drawings, including joint details and materials of construction for all hardware signed and sealed by the qualified professional engineer responsible for their preparation.
 - b) Summary of engineering design criteria with Oregon Structural Specialty Code references signed and sealed by the qualified professional engineer responsible for their preparation.
 - c) Manufacturers certification that the trusses meet Oregon Structural Specialty Code requirements.

1.3 RELATED SECTIONS

- a. 04200 - Concrete Masonry Units
- b. 07200 - Wall and Ceiling Insulation
- c. 07312 - Roofing, Gutters and Downspouts
- d. 08115 - Hollow Metal Doors and Frames
- e. 09900 - Painting

1.4 WORKMANSHIP

- a. All work shall be performed by skilled tradesman in accordance with approved trade practices.

PART 2: PRODUCTS

2.1 LUMBER

- a. Framing Lumber: (West Coast Lumber Inspection Bureau Grading and Dressing Rules) bearing WCLIB grade, trademark, and mill name of sizes indicated. All dimension lumber to be S4S Douglas Fir No. 2 or better, unless otherwise shown or specified.
- b. Sills and Plates: Pressure-treated Douglas Fir.
- c. Roof Sheathing: 5/8-inch APA rated 24/0 Exposure 1 CDX, unless thicker is shown on the drawings.
- d. Finishing Lumber: VG finish kiln-dried Douglas Fir, Grade B and better, S4S unless otherwise specified or designated. Consider as finish lumber all exposed interior trim and similar items. Where hardwood trim is shown on the drawings, interior finish hardwood shall be select custom grade of the kind shown on the drawings.
- e. Plywood: Conform to DFPA standards for sizes and grades shown. All plywood shall be lumber core. All plywood used for interior ceilings in the DAF building shall be marine grade.
- f. Lap Siding: Lap siding shall be Hardiplank Cedarmill fiber-cement exterior siding as manufactured by James Hardy, or approved equal.
- g. Fascia: No. 1 Western Red Cedar or Douglas Fir or HardiTrim Rustic (*wood grain style*).
- h. Exterior Trim: HardiTrim Rustic (*wood grain style*) or equal.
- i. All material shall be thoroughly seasoned and dry prior to the time of being worked. Any work which checks, cracks or opens at joints or warps shall be removed and replaced.
- j. Lumber stock for finish carpentry shall be well seasoned and kiln dried to a moisture content of not more than 10%. All wood finish and trim shall be protected from dampness and abuse at all times.
- k. All cement board siding & trim shall be provided with a 30 year warranty.

2.2 HARDWARE

- a. Anchors, Joist Hangers, Seismic Hardware: Framing anchors, joist hangers, clips, straps & tie-downs shall conform to the requirements of current Oregon Structural Specialty Code and drawing requirements, whichever is more stringent.
- b. Flashing: Appropriately sized Z flashing shall be provided over the top of all horizontal trim at openings, along the top of belly bands, or similar areas as required to ensure that water cannot penetrate behind siding or trim.
- c. Nails, Fastenings and Hardware:
 - 1) Contractor shall supply all necessary hardware to complete the work or as shown on the drawings or details. All nails, bolts, washers, spikes, hardware, etc. shall be

galvanized commercial grade products of recognized manufacturers and suitable for intended use.

- 2) Bolts, nuts and washers shall be hot dip galvanized.
- 3) Galvanized steel plyclips shall be provided for use on roof sheathing at all joints between roof trusses or rafters at spacing summarized in Part 3 herein or noted on the plans or details.

d. Door Hardware: Shall be as specified in applicable sections contained herein.

2.3 TRUSSES

- a. Unless otherwise shown on the drawings or approved by the Owner's Representative, roof trusses shall be engineered pre-manufactured trusses meeting the requirements of the International Building Code.

2.4 INSULATION

- a. Insulation shall be as specified in the applicable sections contained herein and shall be installed in accordance with manufacturer's specification.
- b. Insulation shall be the proper width to sit between studs, joists and rafters.

2.5 ROOFING

- a. Building felt and roofing system shall be as shown on the drawings and as specified in the applicable sections contained herein.

2.6 GUTTERS AND DOWNSPOUTS

- a. Gutters and downspouts shall be as shown on the drawings and as specified in the applicable sections contained herein.

2.7 ATTIC/SOFFIT/RAFTER VENTING

- a. Attic and soffit/rafter venting shall be as shown on the drawings and as specified herein.
- b. Unless otherwise shown on the drawings, enclosed soffits shall be provided with continuous aluminum soffit vents. Where enclosed soffits are not provided, aluminum vents shall be provided in truss/rafter blocking.
- c. Gable end vents shall be screened aluminum louver vents with a minimum size of 12-inches square, or as required by Oregon Structural Specialty Code.
- d. Manufactured insulation baffles shall be provided for installation between all trusses, each end, to ensure that ventilation air flow is maintained from the soffit vents into the attic space.

2.8 CABINETS

- a. All cabinets shall be constructed of birch and birch plywood (5-ply, Grade A).
- b. All drawers to be supplied with rollers and metal slides.
- c. Cabinetry hinges and pulls to be by Washington or Ives. Standards, clips and drawer slides by K.V. or Epco.
- d. For shelving, use Int. DFPA, ¾ inch thick birch veneer plywood. Edge band all exposed edges with wood edging similar to the veneer.
- e. Laminated plastic facing material shall be 1/16 inch thick high pressure Thermoset laminated plastic, of color and pattern selected by the Owner's Representative. All material shall be installed in accordance with the manufacturer's specifications and details on the drawings. For curved surfaces, use 0.050 inch post form type material. Back sheets to be 0.020 inch material.

PART 3: EXECUTION

3.1 GENERAL

- a. Measurements for all work joining or connecting to other work shall be taken on the job site and not from the drawings.
- b. Carefully lay out, cut, fit and erect all framing, ledgers, blocking and other items of carpentry as required to provide adequate support, including at the ends of any sheeting, boards, siding, etc.
- c. Providing blocking as necessary to provide support for sheeting, siding, fixtures, other accessories shown to be mounted on or secured to framed walls, ceilings, etc., regardless of whether blocking is detailed on the drawings.
- d. All joints shall be fitted tightly and in a manner to avoid opening of joints later. Keep work plumb, true and in place, free from stains and tool marks.
- e. Only skilled workers shall be employed for interior and exterior finish woodwork, siding, etc. Quality of workmanship throughout shall be in conformance with approved trade practices and shall be acceptable to the Owner's Representative.
- f. Visible edges and surfaces of all woodwork shall be sanded and smoothed ready for the painter, free from dirt, saw, tool or planer marks. Sand out all tool marks left from installation.
- g. Back Priming: Surfaces of millwork and lumber which will be in contact with masonry or concrete shall be back primed before erection in accordance with the latest specifications of the National Woodwork Manufacturers' Association, "Minimum Standard for Treatment of Woodwork Products."

- h. Caulk along trim work or where required due to gaps, to provide a continuous surface prior to painting, including joints in plywood walls or ceilings.

3.2 NAILING & MINIMUM NAIL SPACING

- a. Exterior nails shall be galvanized.
- b. All materials shall be sized to an even thickness and shall be firmly bridged, spiked, braced and tied together and shall be nailed as outlined below, except where otherwise shown on the drawings. Other nailing shall be in proportion or as directed or required to be thoroughly secured, including at all edges & ends.
- c. Plywood roof sheathing 8d at 6-inch o.c. at all edges of plywood units; 8d at 12-inch o.c. at intermediate supports; and 8d at 4-inch o.c. at roof opening.
- d. Blocking shall be installed at unsupported edge joints of sheathing where required to address deflection under foot loading, or where truss spacing exceeds 24" on center, and under all siding as required to support all joints.
- e. If splitting from nailing occurs, and where specifically shown, drill holes slightly smaller than nail size before nailing.

3.3 HARDWARE

- a. Supply and install all hardware including all nails, bolts, spikes, wall ties, anchor bolts, hinges, hasps, flashing, etc., as shown and as required for proper construction.

3.4 PLYWOOD DECKING & SHEATHING

- a. Provide decking/sheathing thickness shown on the drawings (5/8" minimum unless thicker shown on the drawings).
- b. Lay with long dimension perpendicular to supports and stagger joints. Unless otherwise shown on the drawings, nailing schedule shall be as specified herein.
- c. Plyclips.
 - 1) Galvanized steel plyclips shall be provided on all roof decking/sheathing at all joints between roof trusses or rafters, as well as on all wall sheathing at all joints between studs or vertical supports.
 - 2) Plyclip spacing shall be such that no gap between plyclips (*or between a truss/rafter/stud and a plyclip*) exceeds 8" OC.

3.5 ROOFING

- a. Building felt, metal roofing and/or asphalt roofing shall be installed in accordance with the latest edition of International Building Code.

3.6 ATTIC ACCESS & VENTILATION

- a. An attic access opening shall be provided to all attic spaces per Oregon Structural Specialty Code requirements (minimum size 22 by 30 inches), whether shown on the drawings or not. When not shown on the drawings, the opening shall be located in a

corridor, hallway or other readily accessible location with 30-inches or more of unobstructed headroom over the opening in the attic space.

- b. Insulation baffles shall be provided to ensure a minimum of 1½-inch air space between the insulation and the roof sheathing at all locations with eave or cornice vents.

3.7 CABINETRY

- a. Provide all cabinets complete with approved hardware. Shop-assemble all cabinets; make those too large for entrance into use areas in attachable sections for re-connection in final location.
- b. Make cutouts for sinks and lavatories to template for proper fixture; sink rims shall be furnished with sinks and lavatories; coordinate with plumbers for sizes.
- c. Wherever exposed nailing is required use only finish nails, heads set for filling.
- d. Verify all dimensions at building after wall and ceiling finish materials are in place.
- e. Secure upper cabinets to backing in wall in manner as approved to support weight of cabinet and items to be stored therein.
- f. Install floor-supported counters in proper location to true level and properly secure to walls and floors as approved. Cope cabinet and counter face frames to abutting walls and furring above and to adjacent casework.
- g. Sand all exposed surfaces to remove all marks and irregularities and provide smooth finish ready for painters' finish.
- h. Protect all cabinetwork against damage until final completion and acceptance of the building.

PART 4: SPECIAL PROVISIONS

None.

SECTION 06605
FRP SHELTER

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the fabrication and installation of insulated, corrosion resistant fiberglass reinforced polyester (FRP) enclosure for the Plant Pump Station Control Building including all required mounting brackets, fasteners, anchors and other incidental work. The fiberglass enclosures for the samplers are specified in the sampler specification.
- b. This section includes the construction of a concrete base pad of the size and at locations as shown on the drawings, along with all required appurtenances and other incidental work required for a complete installation.

1.2 WARRANTY

- a. FRP enclosures shall be provided with a 10-year warranty on materials and workmanship.

1.3 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the following.
 - 1) Descriptive literature, bulletins or other data from the manufacturer describing the equipment and appurtenances, including with manufacturer's model number and materials of construction.
 - 2) Approval drawings showing interior and exterior dimensions. Descriptive literature describing materials of construction, anchor bolt locations and size of fasteners.
 - 3) Manufacturer's installation instructions.
 - 4) Catalogue cut sheets for all appurtenances such as doors, door hardware, sealant, , exhaust fans, intake louvers, etc.
 - 5) Structural calculations for the shelter including anchor bolt calculations. Calculations shall be sealed by a Professional Engineer registered in the State of Oregon.

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:
 - 1) Orenco Composites, Durafiber Buildings
 - 2) Plastifab, Inc., Guardian Shetler

2.2 GENERAL

- a. Interior & exterior wall & roof color shall be as selected by the Owner, based on standard color cards or samples provided by the manufacturer.
- b. Fiberglass shelter shall be insulated, foam-core, molded fiberglass structure with exterior length & width as shown on the drawings and standard wall height dimension of 8 feet unless otherwise noted or shown on the drawings. Building shall include a 3:12 pitched roof (*14 degree*) with total height of 1.5 feet greater than the wall height.
- c. Roof Overhang. Unless larger overhangs are specified herein or shown on the drawings, the building shall be provided with a 12-inch roof overhang on the front and sides, and a 24-inch overhang on the end with the entry door.
- d. Lift Points. The fiberglass shelter shall be equipped with lifting brackets or lift points to allow lifting the shelter by crane, excavator or similar equipment.
- e. Fiberglass shelter shall be delivered fully assembled with the exhaust fan, intake louver pre-installed and ready to connect to electricity and other utilities as specified. The layout of the equipment inside the shelter shall be arranged as shown on the drawings. No deviations from the layout shown on the drawings will be accepted without prior authorization from the Engineer.

2.3 STANDARDS

- a. The shelter described in this specification shall conform to the standards below as applicable.
 - 1) ASTM C 581: Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service
 - 2) ASTM D 2584: Standard Test Method for Ignition Loss of Cured Reinforced Resins
 - 3) ASTM D 790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

- 4) ASTM D 2583: Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
- 5) ASTM D 2563: Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts

2.4 STRUCTURAL REQUIREMENTS.

- a. Fiberglass shelter shall be capable of withstanding 130 mph wind loads when properly anchored. The roof shall be capable of handling a 100 psf live load.

2.5 MATERIALS AND CONSTRUCTION

- a. Fiberglass shelter shall be manufactured from fiberglass reinforced polyester resin, using grades of resin and fiberglass considered acceptable for use in water and wastewater environments. Insulation foam shall be a minimum 2 lb/cu. ft. polyurethane or polyisocyanurate. Inside and outside surfaces shall be protected with a coating designed for continuous outdoor exposure. Outer walls color shall be Olivine (*light grey*), Molding color and internal wall color shall be Filament (*lighter grey*). Roof shall be textured and graphite in color.
- b. Walls and Ceiling. Fiberglass shelter shall be molded and use a closed-molded RTM or vacuum-bagging process to ensure integral bonding of the foam core with the fiberglass laminates. Walls and ceiling shall be from 3" - 4" thick with a minimum insulation value of R18. The fiberglass laminate on either side of the foam core shall be a minimum 0.17 inches thick. Integral pocket flanges shall be built into the bottom of the walls for securing the building to a concrete slab.
- c. Door and Frame Construction.
 - 1) Door shall be a seamless, molded, one-piece unit that is made using a closed-molded RTM or vacuum-bagging process to ensure integral bonding of the foam core with the fiberglass laminates. The door shall be 1.5" thick foam core with a minimum laminate thickness of 0.17 inches. Internal reinforcement shall be continuous within the door structure to allow for mounting of specified hardware.
 - 2) Door frame shall be a molded fiberglass frame that is structurally bonded to the building. Frame shall use a foam core with a minimum laminate thickness of 0.17 inches.
- d. Doors and Hardware. Fiberglass shelter shall be furnished with a fiberglass door and fiberglass frame. Door width shall be 36 inches. Door height dimension shall be 80 inches.
 - 1) Hinges. The door shall be hung on a minimum of three 4-inch x 4-inch stainless steel ball bearing hinges with non-removable pins. The hinges shall be bolted through the door jam with 304 stainless steel fasteners.
 - 2) Door Handle & Lock. Doors shall be supplied with commercial grade lever type handles Schlage D-Series "Rhodes" series (*lever style*) or approved equal. Locks

shall be heavy duty. Each cylinder shall have 6-pin tumblers capable of being rekeyed by the Owner.

Outside Handle Opened by Key Only. Unless otherwise specified, all door handles & locks on exterior doors of buildings shall be configured so that the outside handle is opened by key only, while the inside handle is always unlocked (*no push-button or turn-button lock on interior*). Panic hardware shall be provided on the interior of the door where required by code.

- 3) Kick Plates. Doors shall be provided with full width stainless steel kick plates on both sides (*304SS, 0.05" minimum thickness with countersunk screw holes*). Kickplate height shall be a minimum of 12-inches.
- 4) Overhead Door Stop/Holder. An overhead door stop/holder shall be provided on each door. Overhead door stops shall be designed to operate between 85° and 110°, and shall have integral shock absorbers that “give” approximately 5°-7° to protect the door from violent opening. The “dead stop” templating shall be set approximately 5°-7° less than the point of required dead stop to accommodate the compression of the shock absorber. Overhead door stop/holders shall be Glynn-Johnson 81H series (*surface-mount hold-open model*) with US32D finish (*brushed stainless steel*) or approved equal, with all stainless steel mounting hardware. Any through bolts shall have sex head bolts on the exterior of the door.
- 5) Weather Stripping. All doors shall be provided with weather stripping & low profile thresholds, or door sweeps where the drawings specify no threshold.
 - a) Unless otherwise shown or specified, weatherstripping shall be rigid jam type with metal retainers fastened to the door or the door jam (*no glue-on weather stripping allowed*). The metal retainer portions shall be anodized aluminum, color dark bronze unless otherwise selected by the owner. Weatherstripping shall be provided with hollow bulb silicon seals (*positive pressure, smoke and fire rated*), Pemko 303DS or approved equal. Pile seals are not acceptable.
 - b) Door Sweeps. Door sweeps shall be filament brush style consisting of densely compressed nylon filaments encased in aluminum retainers, Pemko 18062 series or approved equal. Brush filaments shall remain flexible to temperatures down to -30°F. The metal retainer portions shall be anodized aluminum, color dark bronze unless otherwise selected by the Owner.

The slope of the floor over the door opening area and the length of the bottom door sweep shall be such that the doors can open over their entire range without jamming against the floor, while providing an airtight seal when the door is closed.

2.6 PROVIDED OPTIONS.

- a. The shelter shall be furnished with the following equipment. All equipment shall be installed prior to shipment.
- b. All required anchor bolts for mounting the shelter to the concrete slab. Bolts shall be 304 stainless steel.
- c. Sealant for sealing the shelter to the concrete pad. Sealant shall be a high tack butyl rubber sealant ConSeal CS-250 or approved equal.
- d. Intake Louver. The shelter shall be equipped with an intake louver with an insect screen. The louver shall sized to limit the air intake velocity to less than 900 feet per minute. If the intake louver is in the door, louvers are to be solid fiberglass inverted “V” vanes matching the color, texture and finish of the doors, unless otherwise approved by the Owner’s Representative.
- e. Ventilation Fan. Inline exhaust fan having a free air capacity of 400 CFM @ 0.00 in SP. The fan shall be mounted high on a wall to exhaust the air from the shelter and shall be thermostatically controlled. Fantech FR200 or approved equal with all required duct work. Exhaust vent shall be fitted with rain protection louvers or equivalent, and an insect screen on the exterior of the shelter.
- f. The shelter shall be equipped with a 30” White Baseboard Heater, 1706 BtuH, 500 Watts, 120/240 Volts, 4.2 Amps, Single Phase. Heater shall be thermostatically controlled with a wall mount thermostat double pole, snap action, Temperature range of 50 to 80 degrees.
- g. Contractor Provided Panels/Components. The shelter supplier shall provide means, such as backing, mounting brackets, fiberglass struts, etc. for mounting all electrical equipment within the shelter. The control shelter supplier shall be responsible for coordinating the final dimensions, weights, and mounting requirements of all wall mounted equipment furnished and installed by the Contractor. The control shelter supplier and/or the Contractor shall provide all conduit and wiring as required for a complete and fully functioning system.

PART 3: EXECUTION

3.1 INSTALLATION

- a. Unless otherwise shown on the drawings, the mounting pad shall be set a minimum of 2-inches above finish grade, with the surrounding ground graded to drain away from the enclosure.
- b. The FRP enclosure walls shall be plumb and the enclosure shall be securely anchored in place with 5/8-inch minimum diameter stainless steel anchor bolts.
- c. All equipment and systems shall be securely mounted in the FRP enclosure in conformance with the drawings, specifications and all applicable codes and regulations.

PART 4: SPECIAL PROVISIONS

None.

SECTION 06660
FRP PARSHALL FLUME

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the fabrication and installation of FRP Parshall flume, along with all required fasteners, anchors and other incidental work.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*). as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents shall include:
 - 1) Descriptive literature, bulletins or other data from the manufacturer describing the equipment and appurtenances, including with manufacturer's model number and materials of construction.

PART 2: PRODUCTS

2.1 FLUME

- a. Flume dimensions to be U.S. Department of Agriculture standard dimensions, with a throat width as shown on the drawings.
- b. The flume shall be full length, molded fiberglass reinforced polyester laminated in one piece. The flume shall be one integrally molded piece consisting of an approach or converging inlet section, a throat and a diverging outlet section.
- c. The interior surface of the flume shall be smooth and free of irregularities, and shall have a 10 to 15 mil UV resistant white gelcoat backed by a resin rich layer of resin and chopped glass forming a water and chemical resistant surface. The remainder of the laminate shall be fiberglass reinforced polyester containing not less than 30% glass content by weight. The thickness of the walls and floor of the flume shall be not less than 1/4-inch.
- d. Typical physical properties shall be as follows.
 - Tensile strength 14,000 psi
 - Percent elongation 1.65%
 - Flexural strength 25,000 psi
 - Flexural modulus 0.90×10^6 psi
 - Barcol hardness 30
- e. Flume dimensions shall be within plus or minus 1/16-inch for flumes 12-inch and smaller. For 18-inch to 24-inch flumes, the tolerance shall be plus or minus 3/32-inch in the throat and plus or minus 1/8-inch elsewhere. Flumes 30-inch through 48-inch shall be

plus or minus 1/8-inch in the throat and plus or minus 1/4-inch elsewhere. The dimensions shall be verified by the Contractor both before and after installation and concrete placement.

- f. The flume shall be reinforced with box section stiffeners down the sides and across the bottom. The stiffeners shall be joined together at the knee to form a rigid dimensionally stable flume. The flume shall be free standing, strong enough to hold a 30" depth of water without visible distortion. There shall be rows of locking clips fastened along the side of the flume to be used for anchorage into the concrete. Flumes requiring external anchoring bolts shall not be permitted.
- g. The Parshall flume shall be provided with a molded in head gage on the left side of the flume (facing upstream) graduated in feet. The foot scale shall be graduated in half tenths with 3/4" high black numerals at each tenth.
- h. Stiffeners across the top shall be permanent FRP angle/channel or temporary wood spreaders as required for the job, and shall provide sufficient strength and structural support to resist the stresses that occur during shipping and proper installation of the flume, including concrete placement.
- i. The flume shall be provided with an adjustable T-304 stainless steel support bracket to mount an ultrasonic transducer over the waterway to fit the transducer of the flowmeter specified.
- j. The flume shall be as manufactured by Plasti-Fab, Inc. of Tualatin Oregon or approved equal.

2.2 FABRICATION

- a. The inner surface of the flume shall be smooth and resin rich. The outer surface shall be reasonably smooth with no glass fiber exposed. The size and number of air bubbles shall be held to a minimum. Lamination, when necessary, shall be dense and without voids, dry spots, cracks or crazes.

PART 3: EXECUTION

3.1 INSTALLATION

- a. Flume shall be installed as shown on the drawings and as recommended by the manufacturer.
- b. The flume should be installed level end-to-end and side-to-side, and shall remain level in both directions after concrete placement.
- c. The top cross ties (stiffeners) shall be left on the flume until it has been installed. If the flume is set in concrete the cross ties can be removed after installation.
- d. Secure the 2" x 2" angle clips on flume with 4-inch long 1/4-inch bolts (with two nuts to center the bolt in the clip) and secure to rebar with tie-wire to key the flume into the concrete. (Concrete does not bond well to fiberglass).

The 2' x 2" angle clips are not made to prevent shifting during concrete placement. Additional cross beams and/or bracing, temporarily anchored into the channel wall or adjacent bench, shall be provided as necessary to prevent possible floating during installation.

- e. Shore the inside walls of the flume as necessary in order to keep the side-walls plumb and maintain the dimensional integrity of the flume. The throat is the most critical portion of the flume to protect. Provide adequate bottom support for flume and approach to prevent settling or shifting. Unless otherwise approved by the Owner's Representative, the Contractor shall fill the flume with moist sand prior to concrete placement against flotation, deflection of the sidewalls, as well as protection against concrete spillage.
- f. At the contractor's option, the flume can be grouted into a block out in the concrete channel to lessen the chance of wall deflection. If the flume is being placed in concrete, concrete placement must be in lifts and slow enough so as not to bulge the sides and floor of the flume. Care should be taken to avoid excessive use of a vibrator, which can also cause distortion.

PART 4: SPECIAL PROVISIONS

None.

DIVISION 7

THERMAL AND MOISTURE PROTECTION

SECTION 07200
WALL AND CEILING INSULATION

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing all thermal insulation for structures, all fastenings, framework and any other incidental work necessary for completion of the work.

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*) as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include for review purposes:
 - 1) Manufacturer's literature.
 - 2) Manufacturer's certifications.
 - 3) Samples: Two 8" x 8" pieces of each type and thickness of insulation used.

PART 2: PRODUCTS

2.1 GENERAL

- a. The insulation shall not rot, disintegrate, slump, or leave uninsulated voids, shall not provide sustenance to vermin, rodents, insects, bacteria, or fungi, and shall not react with or accelerate corrosion of steel, aluminum, or copper.
- b. Insulation which is combustible shall be treated with a fire retardant and installed properly. Such insulation shall not be left exposed.
- c. The insulation shall retain its thermal capacity for a minimum of 20 years.
- d. Insulation shall be odorless.

2.2 INSULATION:

- a. Fiberglass Insulation
 - 1) Unless otherwise noted, batts and blankets shall be fiberglass with integral vapor barriers. The insulation shall have a thermal conductivity not exceeding 0.32 Btu/hr/°F/in. of thickness/S.F. The thickness shall be as indicated on the plans and details or as specified herein.
 - 2) Where not otherwise specified or shown on the drawings, fiberglass Insulation shall be R-19 kraft or foil faced fiberglass blankets for walls and R-38 kraft or foil faced fiberglass blankets for ceilings, and shall be the proper width to sit between framing.

b. Rigid Insulation

- 1) Rigid insulation shall be extruded polystyrene foam Styrofoam board as manufactured by the Owens Corning or equal. Thicknesses shall be as indicated on the plans and details.

c. Masonry Insulation

- 1) Block insulation shall be expandable polystyrene block inserts individually molded to have a minimum density of 1.0 P.C.F., and shall conform to ASTM C578 Standard Type 1. Insulation shall be KORFIL Block Insulation as produced by Concrete Block Insulating Systems, Inc. or approved equal, configured to allow all blocks with inserts to be solid grouted as specified.

2.3 INSULATION BAFFLES:

- a. Full width rigid foam insulation baffles shall be provided and installed for each end of each truss space (*or other space where free ventilation air flow is required*).
- b. The insulation baffle ventilation system shall be polystyrene foam construction, lightweight and moisture resistant and provided with an integrated end baffle, designed to install between rafters to provide an unobstructed air channel through insulation to help keep air flowing freely from eave/soffit vents to ridge vents.
- c. Insulation baffles shall be water resistant and durable, blocking out moisture and wind from penetrating the attic.
- d. Insulation baffles shall be designed to fit between the rafters or trusses with the vent's cones pushed up against the roof deck, with side nailing flanges to allow the vent to be secured in place by stapling the wide nailing flanges to the truss and to the ceiling perimeter sheathing blocking (*ie. fastened at inside edge of the top plate*).
- e. The integrated baffle shall be provided with a bend-down air stop/insulation-block which is fastened to the top plate of the wall. The bend-down air stop/insulation-block feature shall prevent insulation from filling the eave space or covering or blocking vent holes. The bend-down air stop/insulation-block feature shall provide space (*from the blocking material at the front edge of the wall top plate*) to provide for unobstructed air flow.
- f. Insulation baffles shall be Raft-R-Mate polystyrene baffles by Owens-Corning, or approved equal.

PART 3: EXECUTION

3.1 DELIVERY, HANDLING AND STORAGE

- a. Delivery, handling, and storage shall be in conformance with the requirements of these Contract Documents.

3.2 INSTALLATION

- a. Insulation shall be installed in the locations shown on the plans and details, and shall be installed in accordance with the recommended installation procedures as outlined by the manufacturer and as specified herein.
- b. The type and thickness of wall insulation is shown on the drawings or specified herein. No substitutions shall be considered which would require changes in the construction dimensions of the building walls.
- c. Prior to installation of any insulation, Contractor shall inspect all surfaces to be covered by insulation material and notify the Owner's Representative of any defects. Surfaces to be covered shall be thoroughly dry and free of dirt, dust, and debris. Insulation shall not be installed when the temperature is below 40°F or during wet weather. Insulation shall not be installed until construction has proceeded to the point that inclement weather will not wet or damage the insulation.
- d. During installation, cover and protect exposed insulation at the end of each working day or at the onset of inclement weather. Any insulating material that becomes wet and/or damaged shall be removed and replaced at the contractor's expense to the satisfaction of the Owner's Representative.
- e. Insulation baffles shall be provided to ensure a minimum of 1½-inch air space between the insulation and the roof sheathing at all locations with eave or cornice vents.

PART 4: SPECIAL PROVISIONS

None.

SECTION 07411 METAL ROOF PANELS

PART 1: GENERAL

1.1 SCOPE

- a. Section Includes:
 - 1) Standing-seam metal roof panels, accessories, gutters, and downspouts.

1.2 PERFORMANCE REQUIREMENTS

- a. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- b. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1) Uplift Rating: UL 90
- c. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592.
 - 1) Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a) Uniform pressure: See Wind Loads in Drawings, Page S001.
 - 2) Snow Loads: 25 lbf/sq. ft. (ASD), 35 lbf/sq. ft. (Ultimate)
 - 3) Deflection Limits: Metal roof panel assemblies shall withstand wind and snow loads with vertical deflections no greater than 1/180 of the span.

1.3 SUBMITTALS

- a. American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item).
- b. Product Data: For each type of product indicated.
- c. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and end lap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory and field assembled work.
- d. Samples: For each type of exposed finish required.

- e. Coordination Drawings: Roof plans, drawn to scale, based on input from installers of the items involved.
- f. Manufacturer Certificates: Signed by manufacturer certifying that roof panels comply with energy performance requirements specified in “Performance Requirements” Article.
 - 1) Submit evidence of meeting performance requirements.
- g. Product test reports.
- h. Field quality-control reports.
- i. Maintenance data.
- j. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- a. Installers Qualifications
 - 1) Installer must be approved by the panel Manufacturer in writing prior to work commencing.
 - 2) Installer shall meet the following:
 - a) Successfully applied five metal roofs of comparable size and complexity in the region where the work will be performed.
 - b) Have been in business for minimum of 5 years in the region where the work will be performed.
- b. Manufacturer’s Qualifications
 - 1) Manufacturer shall have a minimum of 10 years’ experience supplying metal roofing to the region where the work is to be done.
 - 2) Manufacturer shall provide proof of liability insurance for their metal roof system and comply with current independent testing and certification as specified.
 - 3) Manufacturer shall inspect installation twice a week.

1.5 WARRANTY

- a. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1) Warranty Period: Two years from date of Substantial Completion.

- b. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1) Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2: PRODUCTS

2.1 PANEL MATERIALS

- a. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ATM a 755/A 755M.
 - 1) Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 - 2) Surface: Smooth, flat finish.
 - 3) Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.
 - 4) Concealed Finish: Manufacturer's standard white or light-colored acrylic or polyester backer finish.
- b. Panel Sealants:
 - 1) Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; ½ inch wide and 1/8 inch thick.
 - 2) Joint Sealant: ASTM C 920; as recommended in writing by the metal roof panel manufacturer.
 - 3) Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.2 UNDERLAYMENT MATERIALS

- a. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.3 MISCELLANEOUS MATERIALS

- a. Panel Fasteners: Per manufacturer's recommendations.

2.4 STANDING-SEAM METAL ROOF PANELS

- a. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnection raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleat, pressure plates, and accessories required for weathertight installation.

- 1) Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
- 2) Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.
- 3) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work Include, but are not limited to, the following:
 - a) AEP-Span.
 - b) Architectural Building Components.
 - c) Architectural Metal Systems.
 - d) Architectural Roofing and Siding Inc.
 - e) ATAS International Inc.
 - f) Berridge Manufacturing Company.
 - g) Butler Manufacturing; a BlueScope Steel Company.
 - h) CENTRIA Architectural Systems.
 - i) Copper Sales Inc.
 - j) Dimensional Metals Inc.
 - k) Englert Inc.
 - l) Fabral.
 - m) Flexospan Steel Buildings Inc.
 - n) Galvamet; Galvacer Building Systems.
 - o) IMETCO
 - p) Integris Metals.
 - q) MBCI; a division of NCI Building Systems L.P.
 - r) McElroy Metal Inc.
 - s) Merchant & Evans.
 - t) Metal-Fab Manufacturing LLC.
 - u) Metal Sales Manufacturing Corporation.
 - v) Metecno-Morin; Division of Metecno Inc.
 - w) Modern Metal Systems Inc.
 - x) Petersen Aluminum Corporation.
 - y) Steelox Systems L.L.C.
 - z) Ultra Seam Incorporated.
 - aa) United Steel Deck Inc.; Subsidiary of Bouras Industries Inc.
 - bb) VICWEST; Div. of Jenisys Engineered Products.
- 4) Profile: Vertical-rib, Self-locking-joint, as indicated on Drawings.
- 5) Material: Zinc-coated (galvanized) steel sheet, 24 gage nominal thickness.
 - a) Exterior Finish Siliconized polyester.
 - b) Color: As selected by Owner's Representative from manufacturer's full range.
- 6) Clips: Concealed fastener clip per manufacturer's recommendations.

- 7) Joint Type: As standard with manufacturer.
- 8) Panel Coverage: 17 inches.
- 9) Panel Height: 2 inches.

2.5 ACCESSORIES

- a. Roof Panel Accessories: Provide components approved by roof panel manufacturer and as required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge vents, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
 - 1) Closures: Provide closure at eaves and ridges, fabricated of same metal as metal roof panels.
 - 2) Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or pre-molded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 - 3) Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- b. Continuous Ridge Vent: Continuous ridge vents shall be installed on each structure with a metal roof. The ridge vent shall be furnished by the panel manufacturer of the same material, finish, and color used for the roof panels. The vent shall be designed to prevent water from entering the vent and shall be equipped with a bug screens to cover all openings.
- c. Flashing and Trim: Formed from same material as roof panels, pre-painted with coil coating, minimum 0.018 inch thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.
- d. Gutters: Formed from same material roof panels. Match profile of gable trim, complete with end pieces, outlet tubes and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
- e. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual". Finish downspouts to match gutters.
- f. Roof Curbs: Fabricated from same material as roof panels, minimum 0.048 inch thick; with bottom of skirt profiled to match roof panel profiles, and welded top box and integral full-length cricket. Fabricate curb sub-framing of minimum 0.0598-inch-thick,

angle-, C- or Z-shaped steel sheet. Fabricate curb and sub-framing to withstand indicated loads, of size and height indicated. Finish roof curbs to match metal roof panels.

- 1) Insulate roof curb with rigid insulation.

2.6 FABRICATION

- a. Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
- b. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- c. Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within panel assembly.
- d. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal and other characteristics of item indicated.

PART 3: EXECUTION

3.1 PREPARATION

- a. Miscellaneous Framing: Install sub purlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written instructions.

3.2 UNDERLAYMENT INSTALLATION

- a. Apply slip sheet underlayment before installing metal roof panels.

3.3 THERMAL INSULATION INSTALLATION

- a. Board Insulation: Extend insulation in thickness indicated to cover entire roof. Comply with installation requirements in Division 7 Section "Building Insulation."

3.4 METAL ROOF PANEL INSTALLATION

- a. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing seam joint at location, spacing, and with fasteners recommended by manufacturer.
 - 1) Install clips to support with self-tapping fasteners.

- 2) Install pressure plates at locations indicated in manufacturer's written installation instructions.
- 3) Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
- 4) Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

3.5 ACCESSORY INSTALLATION

- a. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1) Install components required for a complete metal roof panel assembly including trim, copings, ridge vents, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 2) Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.6 CLEANING

- a. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

PART 4: SPECIAL PROVISIONS

None.

**SECTION 07920
JOINT SEALANTS**

PART 1: GENERAL

1.1 SCOPE

- a. Section Includes:
 - 1) Silicone joint sealants.
 - 2) Urethane joint sealants.
 - 3) Latex joint sealants.
 - 4) Preformed joint sealants.
 - 5) Acoustical joint sealants.

1.2 PRESCONSTRUCTION TESTING

- a. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers samples of materials that will contact or affect joint sealants. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- b. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.3 SUBMITTALS

- a. Product Data: For each joint-sealant product indicated.
- b. Samples: For each kind and color of joint sealant required.
- c. Joint-Sealant Schedule: Include the following information:
 - 1) Joint-sealant application, joint location, and designation.
 - 2) Joint-sealant manufacturer and product name.
 - 3) Joint-sealant formulation.
 - 4) Joint-sealant color.
- d. Product test reports.
- e. Preconstruction compatibility and adhesion test reports.

f. Preconstruction field-adhesion test reports.

g. Field-adhesion test reports.

h. Warranties.

1.4 QUALITY ASSURANCE

a. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 WARRANTY

a. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1) Warranty Period: Two years from date of Substantial Completion.

b. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1) Warranty Period: 20 years from date of Substantial Completion.

PART 2: PRODUCTS

2.1 MATERIALS, GENERAL

a. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Sub part D (EPA Method 24):

1) Architectural Sealants: 250 g/L.

2) Sealant Primers for Nonporous Substrates: 250 g/L.

3) Sealant Primers for Porous Substrates: 775g/L.

b. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class and uses related to exposure and joint substrates.

1) Suitability for Immersion in Liquids. Where sealants are indicated for Use 1 for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants in deionized water, unless otherwise indicated.

- c. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.2 SILICONE JOINT SEALANTS

- a. Mildew-Resistant-Neutral-Curing Silicone Joint Sealant: ASTM C 920.
 - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) BASF Building Systems.
 - b) Dow Corning Corporation.
 - c) GE Advanced Materials – Silicones.
 - d) May National Associates Inc.
 - e) Pecora Corporation.
 - f) Polymeric Systems Inc.
 - g) Schnee-Morehead Inc.
 - h) Sika Corporation; Construction Products Division.
 - i) Tremco Incorporated.
 - 2) Type: Single component (S).
 - 3) Grade: Nonsag (NS).
 - 4) Class: 25.

2.3 URETHANE JOINT SEALANTS

- a. Urethane Joint Sealant: ASTM C 920.
 - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) BASF Building Systems.
 - b) Bostik Inc.
 - c) Lymtal International Inc.
 - d) May National Associates Inc.

- e) Pacific Polymers International Inc.
 - f) Pecora Corporation.
 - g) Polymeric Systems Inc.
 - h) Schnee-Morehead Inc.
 - i) Sika Corporation: Construction Products Division.
 - j) Tremco Incorporated.
- 2) Type: Single Component (S).
 - 3) Grade: Nonsag (NS).
 - 4) Class: 25.

2.4 LATEX JOINT SEALANTS

- a. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) BASF Building Systems.
 - b) Bostik Inc.
 - c) May National Associates Inc.
 - d) Pecora Corporation.
 - e) Schnee-Morehead Inc.
 - f) Tremco Incorporated.

2.5 PREFORMED JOINT SEALANTS

- a. Preformed Foam Joint Sealant: Manufacturer's standard preformed, pre-compressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb. /cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in pre-compressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

- 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Dayton Superior Specialty Chemicals.
 - b) EMSEAL Joint Systems Ltd.
 - c) Sandell Manufacturing Co.
 - d) Schul International Inc.
 - e) Willseal USA LLC.

2.6 ACOUSTIACL JOINT SEALANTS

- a. Acoustical Joint Sealant: Manufacturer's standard non sag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1) Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) Pecora Corporation.
 - b) USG Corporation.

2.7 JOINT SEALANT BACKING

- a. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- b. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.8 MISCELLANEOUS MATERIALS

- a. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- b. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

- c. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3: EXECUTION

3.1 PREPARATION

- a. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
 - 1) Remove laitance and form-release agents from concrete.
 - 2) Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- b. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- c. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

- a. Sealant Installation Standard: comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- b. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1) Do not leave gaps between ends of sealant backings.
 - 2) Do not stretch, twist, puncture, or tear sealant backings.
 - 3) Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- c. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- d. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1) Place sealants so they directly contact and fully wet joint substrates.

- 2) Completely fill recesses in each joint configuration.
 - 3) Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- e. Tolling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
- 1) Remove excess sealant from surfaces adjacent to joints.
 - 2) Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3) Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- f. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.
- g. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 FIELD QUALITY CONTROL

- a. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
- 1) Extent of Testing: Test completed and cured sealant joints as follows:
 - a) Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b) Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
 - 2) Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- b. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

- a. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

- 1) Joint Locations:
 - a) Isolation and contraction joints in cast-in-place concrete slabs.
 - b) Joints between different materials listed above.
 - 2) Joint Sealant: Silicone.
 - 3) Joint Sealant: Urethane.
 - 4) Joint Sealant: Preformed foam.
 - 5) Joint-Sealant Color: As selected by Owner's Representative from manufacturer's full range of colors.
- b. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
- 1) Joint Locations:
 - a) Construction joints in cast-in-place concrete.
 - b) Joints between plant-precast architectural concrete units.
 - c) Control and expansion joints in unit masonry.
 - d) Joints in exterior insulation and finish systems.
 - e) Joints between metal panels.
 - f) Joints between different materials listed above.
 - g) Perimeter joints between materials listed above and frames of doors, windows, and louvers.
 - h) Control and expansion joints in ceilings and other overhead surfaces.
 - i) Other joints as indicated.
 - 2) Joint Sealant: Silicone.
 - 3) Joint Sealant: Urethane.
 - 4) Joint Sealant: Preformed foam.
 - 5) Joint-Sealant Color: As selected by Owner's Representative from manufacturer's full range of colors.
- c. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

- 1) Joint Locations:
 - a) Isolation joints in cast-in-place concrete slabs.
 - b) Other joints as indicated.
 - 2) Joint Sealant: Silicone.
 - 3) Joint Sealant: Urethane.
 - 4) Joint Sealant: Preformed foam.
 - 5) Joint-Sealant Color: As selected by Owner's Representative from manufacturer's full range of color.
- d. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces.
- 1) Joint Locations:
 - a) Control and expansion joints on exposed interior surfaces of exterior walls.
 - b) Perimeter joints of exterior openings where indicated.
 - c) Vertical joints on exposed surfaces of interior unit masonry, walls, and partitions.
 - d) Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - e) Other joints as indicated.
 - f) Joint Sealant: Latex.
 - g) Joint-Sealant Color: As selected by Owner's Representative from manufacturer's full range of colors.
- e. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.
- 1) Joint Sealant Location:
 - a) Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b) Other joints as indicated.
 - 2) Joint Sealant: Silicone.

- 3) Joint-Sealant Color: As selected by Owner's Representative from manufacturer's full range of colors.
- f. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal non-traffic surfaces.
 - 1) Joint Location:
 - a) Acoustical joints where indicated.
 - b) Other joints as indicated.
 - 2) Joint Sealant: Acoustical.
 - 3) Joint-Sealant Color: As selected by Owner's Representative from manufacturer's full range.

PART 4: SPECIAL PROVISIONS

None.

DIVISION 8

DOORS AND WINDOWS

SECTION 08115
HOLLOW METAL DOORS AND FRAMES

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing of all materials, equipment and labor required to install hollow metal doors and frames as shown on the drawings and as required to complete the work.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item).
 - 2) Shop drawings and manufacturer's literature, including:
 - a) Materials of construction and dimensions of all components.
 - b) Details of core, stile and rail construction, trim for lites and all other components.
 - c) Details of anchors, joint system, expansion provisions, thresholds, and other components.
 - d) Finish hardware schedule.
 - e) Color charts.
 - f) Manufacturer's warranty information (3 year minimum on all components).
 - 3) Samples:
 - a) Samples of finish, frame corner construction, door construction and glazing frame.
 - b) Samples shall be clearly identified as to location and type of finish.
 - 4) Written verification from the Contractor that all components and equipment that the contractor plans to place after the doors are in place can fit through the finish door frame opening.

PART 2: PRODUCTS

2.1 GENERAL

- a. All doors and frames shall be of steel construction and conform to Steel Door Institute standard SDI 100.
- b. All materials utilized for fabrication of doors and frames shall be free from defects impairing their strength, durability or appearance.

- c. All doors and frames furnished for use in this section shall be of one manufacturer unless specifically shown otherwise. The doors shall be reinforced, drilled, and fitted for all hardware at the manufacture's plant. Doors shall be prefit to the frame assembly at the factory (ie. pre-hung) prior to shipment.
- d. When possible, all doors and frames furnished for use in this section shall be of one manufacturer unless specifically shown otherwise.
- e. The Contractor shall perform any required field measurements and verification of existing dimensions and information prior to fabrication and furnishing of materials.
- f. The finish of doors and frames shall be free of scratches, defects, die lines, or blemishes.
- g. Doors and frames shall be as manufactured by Steelcraft, Deansteel, Amweld or approved equal.

2.2 DOORS

- a. Doors shall be 1-3/4-inches thick and made of commercial quality, level, cold-rolled / galvanized steel of 18 gauge thickness conforming to the dimensions shown on the drawings.
- b. Unless a specific factory finish coat is specified herein or noted on the drawings, all doors shall be factory prime coated prior to shipment to the site.
- c. Doors shall be constructed to receive hardware specified. The doors shall be reinforced, drilled, and fitted for hardware at the manufacture's plant, including reinforcement plates for the required locks, hinges and overhead door stops and/or overhead door closers.
- d. Hollow metal doors shall be flush type with or without glazing or louvers, or medium-stile entrance type, as shown on drawings and shall have all related hardware.
- e. Corners shall be accurately cut and milled to provide flush hairline joints.
- f. The interior space between face panels shall be filled with honeycomb fiberglass insulation or urethane foam insulation at a minimum density of 3 lbs/C.F.
- g. Each door of double doors shall be hinged to swing independently of the other.
- h. Doors shall be individually packaged in cartons completely covering entire door to prevent damage to door or finish. Doors and frames shall be stored in an upright position in a manner that will prevent rust and damage.
- i. Glazing
 - 1) All glazing shall be factory installed prior to shipment to the jobsite.
 - 2) Glazing shall be provided with exterior glazing stops which are permanent and integral with the rail and stile extrusions. Removable glazing stops with countersunk holes and flathead screws shall be provided on the interior or secure side of the door. Snap-on glazing stops shall not be allowed.

2.3 STEEL FRAMES

- a. Frames shall be supplied by the door manufacture. Doors shall be prefit to the frame assembly (ie. pre-hung) at the factory prior to shipment. Field fabrication of framing using "stick" material is not acceptable.
- b. Frames shall be made of commercial quality, galvanized steel of 16 gauge thickness conforming to the doors and dimensions shown on the drawings.
- c. Unless a specific factory finish coat is specified herein or noted on the drawings, all frames shall be factory prime coated prior to shipment to the site.
- d. Frames shall be knockdown or welded type, and shall be a minimum of 4.75-inch deep for 6-inch thick walls and a minimum of 5.75-inch deep for 8-inch thick walls. Frame thickness (face width) shall be as required for the specified opening, but in no case shall it be less than 1-inch. All framing members shall be accurately milled with flush hairline joints.
- e. Frames shall be factory reinforced in the areas to receive locks, hinges and overhead door stops and/or overhead door closers.
- f. Provide anchors appropriate for wall conditions to anchor frames to the walls.

2.4 HARDWARE

- a. Unless otherwise shown or specified in this section, all door hardware shall be stainless steel.
- b. Preparation and installation of all door hardware shall be by the door manufacturer.
- c. Hinges. A minimum of three heavy-duty stainless-steel full-mortise ball-bearing hinges shall be provided with each door, mounted so that the hinge will operate through a full 180 degrees. The hinge leaves shall be assembled in matching pairs. Fasteners shall be stainless steel. Hinges mounted on the exterior of buildings shall be provided with non-removable hinge pins.
- d. ADA Compliant Opening/Locking Hardware. All levers, locks and handles shall be ADA compliant, including thumb-turns on deadbolts.
- e. Astragal. Each set of double doors shall be provided with a full height astragal on the primary door (tee or overlapping style with integral silicone bulb weather-stripping to seal against the non-primary door, Pemko 355S series or equal), color dark bronze unless otherwise selected by the owner.
- f. Kick Plates. All door shall be provided with full width stainless steel kick plates on both sides (304SS, 0.05" minimum thickness with countersunk screw holes). Kickplate height shall be a minimum of 12-inches.
- g. Top Plates. All doors with overhead door stops or door closures shall be provided with 4" tall stainless steel plates the full width of the door on both sides (304SS, 0.05" minimum thickness with countersunk screw holes). These plates are to protect the

surface of the door and do not replace the required internal door reinforcement.

h. Exterior Doors Handles and Locks

- 1) Door handle and locks for all exterior doors shall be stainless steel Schlage D-Series “Rhodes” series (lever style) with Vandlgard or approved equal. For double doors, the door handle shall be on the primary door, with the strike plate and strike box on the non-primary door.
- 2) Unless otherwise specified, all door handles & locks on exterior doors of buildings shall be configured so that the outside handle is opened by key only, while the inside handle is always unlocked (*no push-button or turn-button lock on interior*).
- 3) For double doors, the non-primary door shall be provided with stainless steel top and bottom locking bolts, either surface mount mounted to the interior of the door (Trimco 3922 or equal) or built into the edge of the door.

i. Interior Door Handles, Locks, Plates

- 1) Door handle and locks for all interior doors shall be stainless steel Schlage ND50PD RHO 626, or approved equal.
- 2) Unless otherwise specified, all door handles & locks on interior doors of buildings shall be configured with push-button locks outside lever until it is unlocked with key or by turning inside lever.

j. Keys and Keying

- 1) Locks shall be heavy duty. Each cylinder shall have 6-pin tumblers capable of being rekeyed by the Owner. Strikes shall be of the box type.
- 2) Locks shall be master-keyed to existing doors according to instructions provided by the Owner.
- 3) Submit keying schedule to Owner’s Representative and Owner for approval (including an explanation of the keying system).
- 4) Four keys shall be furnished for each lock.

2.5 EXTERIOR DOOR STOPS/CLOSURES

- a. All exterior doors shall be furnished with an overhead door stop/holder. Overhead door stops shall be designed to operate between 85° and 110°, and shall have integral shock absorbers that “give” approximately 5°-7° to protect the door from violent opening. The “dead stop” templating shall be set approximately 5°-7° less than the point of required dead stop to accommodate the compression of the shock absorber.
- b. Overhead door stop/holders shall be Glynn-Johnson 81H series (surface-mount hold-open model) with US32D finish (brushed stainless steel) or approved equal, with all stainless steel mounting hardware. Any through bolts shall have sex head bolts on the exterior of the door.

- c. Door Closures. All exterior single-leaf doors and the primary door on double-door sets shall be provided with door closures. Door closures shall be provided with an option for adjusting the stop or hold open angle after installation. Door closures shall be LCN 4041, corrosion resistant aluminum SRI finish, RW/PA arm, or approved equal.

2.6 INTERIOR DOOR STOP/CLOSURES

- a. All interior doors shall be provided with wall mount stops Trimco 1270WV 626, or approved equal.

2.7 WEATHERSTRIPPING

- a. All exterior doors shall be provided with weather stripping, low profile thresholds, and/or door sweeps (unless the drawings specify no threshold).
- b. Weatherstripping
 - 1) Unless otherwise shown or specified, all weatherstripping shall be provided rigid jam type with metal retainers which are fastened to the door or the door jam (no glue-on weather stripping allowed). The metal retainer portions shall be anodized aluminum, color dark bronze unless otherwise selected by the owner.
 - 2) Weatherstripping shall be provided with hollow bulb silicon seals (positive pressure, smoke and fire rated). Pile seals are not acceptable. Weatherstripping shall be Pemko 303DS or approved equal.
- c. Thresholds & Door Sweeps
 - 1) Unless the drawings specify no thresholds, all doors shall be provided with low profile, ADA compliant thresholds, Pemko 271 series or approved equal, color anodized aluminum unless otherwise selected by the owner.
 - 2) Door sweeps shall be brush filament style consisting of densely compressed nylon filaments encased in aluminum retainers, Pemko 18062 series or approved equal. Brush filaments shall remain flexible to temperatures down to -30°F. The metal retainer portions shall be anodized aluminum, color dark bronze unless otherwise selected by the owner.
 - 3) The slope of the floor over the door opening area and the length of the bottom door sweep shall be such that the doors can open over their entire range without jamming against the floor, while providing an airtight seal when the door is closed.

2.8 SILENCERS

- a. Interior doors shall be furnished with silencers that decrease closing noise. Silencers shall be Ives SR64, or approved equal. Three required for each door.

2.9 WORKMANSHIP

- a. All work shall be shop fabricated to required profiles with corners, angles and edges straight and sharp. Fabrication shall be accurate and no warping, waving, buckling or other defects shall be permitted.

2.10 SHOP FINISH

- a. All doors and frames shall be thoroughly cleaned, phosphatized to inhibit corrosion and receive one coat of rust-inhibiting primer paint prior to shipment.

PART 3: EXECUTION

3.1 INSTALLATION OF FRAMES

- a. Frames shall be installed plumb, straight, and true, rigidly secured in place and properly braced. Frames shall be anchored securely to concrete floors.
- b. Fully grouted frames, or adverse temperature conditions requiring anti-freezing substances in plaster or mortar, shall require the inside of the frames to be coated with bituminous water resistant paint.
- c. Frames shall be provided with secure anchorages and provide connections to adjacent construction.
- d. Frames shall be set with a minimum of four anchors on each side.

3.2 INSTALLATION OF DOORS

- a. The Contractor shall install the doors in accordance with the manufacturer's recommendations.
- b. Doors shall be hung with all clearances accurately maintained. Adjust hinges so doors operate smoothly and fit all stops, frames and weather stripping evenly. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding and to remain in place at any angle without being moved by gravitational influence, and latch securely when closed.
- c. Adjust and lubricate locks, operators and hinge after assembly.
- d. Unless otherwise shown or specified thresholds shall be provided on all exterior doors, on doors to chemical storage rooms, or on doors between office and equipment areas. Set thresholds in a bed of mastic and backseal. Bottom, head and jamb weatherstrips shall be adjusted to fit correctly.

3.3 HARDWARE INSTALLATION

- a. Finish hardware shall be applied in a workmanlike manner. Locks shall be set level and with true back sets. The striking plates, opposite same, shall be in exact alignment with latches and bolts.

- b. Upon completion, the Contractor shall check all hardware, fit all keys in their respective locks, and deliver all keys properly tagged to the Owner. Delivery of the keys shall not constitute acceptance of the building.

PART 4: SPECIAL PROVISIONS

None.

SECTION 08315
OVERHEAD COILING DOORS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing of all materials, equipment and labor required to install overhead coiling doors formed with a curtain of interlocking metal slats as shown on the Drawings.
- b. All overhead doors for the Blower Building and the DAF Building shall be coiling doors as specified herein. The overhead doors for the Storage Building shall be sectional overhead doors as specified in Section 08361.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item).
 - 2) Shop drawings and manufacturer's literature, including:
 - a) Materials of construction and dimensions of all components.
 - b) Details of slats and all other components.
 - c) Details of anchors, joint system, and other components.
 - d) Finish hardware schedule.
 - e) Manufacturer's warranty information (3 year minimum).
 - 3) Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
 - 4) Third party testing documentation or manufacturer's literature qualifying door model as meeting required developed wind pressures.
 - 5) Operation and Maintenance Data, include lubrication requirements and frequency, and periodic adjustments required.
 - 6) Seismic Anchorage and Bracing Calculations:
 - a) The Contractor shall retain the services of a Professional Engineer to design an anchorage system for the approved coiling doors to the building structure. The calculations shall comply with the site specific seismic design data and Importance Factors shown on Drawing S001, ACI 318 Chapter 17 and Appendix D, the Oregon Structural Specialty Code and the 2012 edition of the International Building Code. The

calculations and anchorage design shall define a method of securing the overhead coiling doors to the structure in a manner sufficient to withstand the maximum lateral and vertical forces on the door assembly in the fully retracted position in a seismic event. The calculation package shall be sealed by a registered structural or civil engineer licensed in the State of Oregon.

- b) The term “withstand” shall be understood to mean that "the unit will remain in place without separation of any parts from the attachment to the structure when subjected to the seismic forces specified".

1.3 QUALITY ASSURANCE

- a. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 5 years experience.
- b. Installer: Company specializing in performing work of this section with minimum 3 years experience, approved by manufacturer.
- c. All coiling doors shall be sourced from a single manufacturer.
- d. The door curtain, bottom bar, guides, brackets, counterbalance, hood, and all other door components shall be manufactured by a single-source producer of door systems.

PART 2: PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- a. Wind Loads: Design door assembly to withstand wind/suction load of 30 psf, with maximum deflection of 1/120, and without evidencing permanent deformation or disengagement of the door, or door components.
- b. Operation Cycles:
 - 1) Design door assembly, including operator, to operate for not less than 20,000 cycles.
 - 2) One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

2.2 DOOR CURTAIN

- a. Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length across the width of the door without splices.
 - 1) Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, with the following minimum thicknesses: The front slat shall be fabricated from a minimum 20 gauge galvanized steel. The back slat shall be fabricated from a minimum 24-gauge galvanized steel.
 - 2) Curtain Slats: Galvanized steel flat profile slats with a nominal 3.25-inch center-to-center height.
 - 3) Gasket Seal: Provide insulated slats with manufacturer's standard interior-to-exterior thermal break or with continuous gaskets between slats.

- b. Curtain Insulation: Slat cavity shall be filled with CFC-free, foamed-in-place, polyurethane insulation providing a minimum R-value of 7.7 for the door.
- c. Endlocks and Windlocks: Furnish malleable-iron casings, galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Locks shall be attached to each end of alternate curtain slats to maintain curtain alignment and resistance against lateral movement.
- d. Curtain Bottom Bar: The bottom bar shall be two galvanized steel angles, not less than 1-1/2 by 1-1/2 by 1/8 inch thick, bolted back to back to reinforce the curtain in the guides, and shall be furnished with a bottom weather-seal.
- e. Curtain Jamb Guides: Jamb guides shall be galvanized steel angles with a minimum thickness of 3/16 inch. Guides shall be weather stripped with a vinyl weather-seal at each jamb, on the interior and exterior curtain side. Guides shall be equipped with wind-lock bars as required to meet the minimum design wind loads of 30 psf. Furnish slotted bolt holes for guide adjustment. Guides shall be furnished with continuous integral wear strips to prevent metal-to-metal contact and to minimize operational friction and wear.
- f. Galvanized steel brackets shall be furnished to support the counter-balance, curtain and hood.

2.3 COUNTERBALANCING MECHANISM

- a. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- b. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- c. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- d. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold rolled steel, sized to hold fixed spring ends and carry torsional load.
- e. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold rolled steel plate.

2.4 HOOD ENCLOSURE AND FASCIA

- a. The hood shall be minimum 24-gauge galvanized steel internally reinforced to maintain rigidity and shape.

2.5 WEATHERSTRIPPING

- a. All doors of this project (interior and exterior) shall be furnished with resilient weatherstripping assemblies to ensure a complete and weathertight installation.

- b. All door hoods for this project shall be furnished with an internal rubber, neoprene, or vinyl water seal to prevent airflow around the coil.
- c. All doors of this project (interior and exterior) shall be furnished with a weather sealing strip on the door guides to close the space between the guide and the curtain.

2.6 LOCKING DEVICES

- a. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- b. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1) Lock Cylinders: Provide cylinders specified in Division 8 Section "Door Hardware."
 - 2) Keys: Provide three for each cylinder.
- c. Chain Lock Keeper: Suitable for padlock.
- d. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.7 ELECTRICAL DOOR OPERATOR

- a. Furnish all coiling doors with electric operators.
- b. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.
- c. Usage Classification: Standard duty, up to 60 cycles per hour.
- d. Motor Exposure: Exterior, wet, and humid.
- e. Emergency Manual Operation: Chain type.
- f. Obstruction-Detection Device: Automatic photoelectric sensor electric sensor edge on bottom bar; self-monitoring type.
- g. Push Button Remote-Control Station: Interior, Surface Mount.
- h. Other Equipment: Audible and visual signals.
- i. Motor Voltage: 115/230 single phase, 60 Hz.

2.8 CURTAIN ACCESSORIES

- a. Locking Devices: Furnish with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from interior side

- b. Lifting Handles: Furnish emergency lifting handles on interior side of door, finished to match door.

2.9 FINISHES

- a. Curtain Slats: Apply manufacturer's standard prime coat to both faces after forming.
- b. All slats and hood components shall be galvanized per ASTM A-653 and shall receive a rust-inhibitive, roll-coating process, including bonderizing, 0.02 mils thick baked-on prime paint, and 0.6 mils thick baked on powder-coated top coat, with the color selected by the Owner from the manufacturer's full range of colors.
- c. Hot dip galvanized steel angle guides, head plates, operator mounting plates, rolled guides, tension wheels, etc. need not be painted or powder coated, with the exception of the bottom bars which shall be primed and painted to match the color of the curtain.
- d. Exterior doors and interior doors shall be furnished with separate color systems to be selected by Owner's Representative.

2.10 MANUFACTURER

- a. Manufacturers: Subject to compliance with specified requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cookson Company.
 - 2) Cornell Iron Works, Inc.
 - 3) Overhead Door Corporation.
 - 4) Wayne-Dalton Corp.

PART 3: EXECUTION

3.1 INSTALLATION OF FRAMES

- a. Frames shall be installed plumb, straight, and true, rigidly secured in place and properly braced. Frames shall be anchored securely to concrete floors where applicable.
- b. Frames shall be provided with secure anchorages and provide connections to adjacent construction.
- c. Frames shall be set with a minimum of four anchors on each side, or per the manufacturer's recommendations, whichever is more stringent.

3.2 INSTALLATION OF DOORS

- a. The Contractor shall ensure that the doors are installed in accordance with the manufacturer's recommendations and in accordance with the structural attachments defined in the seismic analysis for the door anchorages as specified in this section. Installation shall be by the manufacturer's authorized representative.
- b. Doors shall be hung with all clearances accurately maintained. Adjust frames & guides so doors operate smoothly and fit all stops, frames and weather stripping evenly. Adjust doors in accordance with door manufacturer's maintenance instructions to open and shut without binding, and latch securely when closed.
- c. Adjust and lubricate locks, operators and guides after assembly.

3.3 HARDWARE INSTALLATION

- a. Finish hardware shall be applied in a workmanlike manner. Locks shall be set level and with true back sets. The striking plates, opposite same, shall be in exact alignment with latches and bolts.
- b. Upon completion, the Contractor shall check all hardware, fit all keys in their respective locks, and deliver all keys properly tagged to the Owner. Delivery of the keys shall not constitute acceptance of the building.

3.4 CLEANING AND PROTECTION

- a. Leave door and components clean. Remove labels and visible markings.
- b. Protect assemblies against soiling and deterioration for the remainder of the construction period.
- c. Touch up shop-applied finishes to restore damaged or soiled areas with a method as recommended by the manufacturer and perform final cleaning prior to final acceptance.

PART 4: SPECIAL PROVISIONS

None.

SECTION 08361 SECTIONAL OVERHEAD DOORS

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

- a. All overhead doors for the Blower Building and the DAF Building shall be coiling doors as specified in Section 08315. The overhead doors for the Storage Building shall be sectional overhead doors as specified in this section.
- b. This Section includes the following types of sectional overhead doors:
 - 1) Doors with steel-framed steel panels.
 - 2) Tracks configured for “Regular” lift.
 - 3) Electric operation.

1.2 DEFINITIONS

- a. Operation Cycle: One complete cycle of a door begins with the door in the closed position. The door is then moved to the open position and back to the closed position.

1.3 PERFORMANCE REQUIREMENTS

- a. Structural Performance: Provide sectional overhead doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
 - 1) Wind Load: Uniform pressure (velocity pressure) of 30 lbf/sq. ft., acting inward and outward.
- b. Operation-Cycle Requirements: Design sectional overhead door components and operator to operate for not less than 25,000 cycles.

1.4 SUBMITTALS

- a. American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item).
- b. Product Data: For each type and size of sectional overhead door and accessory. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes. Provide roughing-in diagrams, operating instructions, and maintenance information. Include the following:
 - 1) Setting drawings, templates, and installation instructions for built-in or embedded anchor devices.

- 2) Motors: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.
- c. Shop Drawings: For special components and installations not dimensioned or detailed in manufacturer's data sheets.
 - 1) Wiring Diagrams: Detail wiring for power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring and between components provided by door manufacturer and those provided by others.
- d. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied finishes.
- e. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- f. Manufacturers' Certificates: Signed by manufacturers certifying that they comply with requirements specified in "Quality Assurance" Article. On request, submit evidence of manufacturing experience.

1.5 QUALITY ASSURANCE

- a. Installer Qualifications: Engage an experienced installer who is an authorized representative of the sectional overhead door manufacturer for both installation and maintenance of units required for this Project.
- b. Manufacturer Qualifications: Engage a firm experienced in manufacturing sectional overhead doors similar to those indicated for this Project and with a record of successful in-service performance.
- c. Source Limitations: Obtain sectional overhead doors through one source from a single manufacturer.
 - 1) Obtain operators and controls from the sectional overhead door manufacturer.
- d. Product Options: Drawings indicate size, profiles, and dimensional requirements of sectional overhead doors and accessories and are based on the specific system indicated. Other manufacturers' systems with equal performance and dimensional characteristics may be considered. Refer to Division 1 Section "Substitutions."
- e. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
 - 1) The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

1.6 WARRANTY

- a. Overall Door – 5 Years.
- b. Insulated Windows – 10 Years.

c. Finish – 20 Years.

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:
 - 1) Overhead Door Corporation.
 - 2) Raynor Garage Doors.
 - 3) Wayne-Dalton Corp.

2.2 STEEL SECTIONS

- a. Construct door sections from galvanized, structural-quality carbon-steel sheets complying with ASTM A 653, commercial quality, with a minimum yield strength of 33,000 psi and a minimum G60 zinc coating.
 - 1) Steel Sheet Thickness: 0.040 inch.
 - 2) Exterior Section Face: Flat.
- b. Fabricate door panels from a single sheet to provide sections not more than 24 inches high and nominally 2 inches deep. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weathertight seal, with a reinforcing flange return.
 - 1) Provide door sections with continuous thermal-break construction, separating faces of door.
- c. Enclose open section with not less than 0.064-inch galvanized steel channel end stiles welded in place. Provide not less than 0.064-inch galvanized intermediate stiles, cut to door section profile, spaced at not more than 48 inches O.C., and welded in place.
- d. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized steel bars, struts, trusses or strip steel, formed to depth and bolted or welded in place.
- e. Provide reinforcement for hardware attachment.
- f. Insulation: Manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation, foamed in place to completely fill inner core of section, pressure bonded to face sheets to prevent delamination under wind load and with maximum flame-spread and smoke-developed indices of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely, with no exposed insulation material evident.
 - 1) Steel Sheet Inside Face: 0.022 inch thick.
 - 2) Minimum R-13 panels.

- g. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints, and free of warp, twist, and deformation.
- h. Finish galvanized steel door sections as follows:
 - 1) General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 2) Surface Preparation: Clean galvanized surfaces with nonpetroleum solvent so surfaces are free of oil and surface contaminants.
 - 3) Pretreat zinc-coated steel, after cleaning, with a conversion coating of type suited to organic coating applied over it.
 - 4) Apply manufacturer's standard primer and finish coats to interior and exterior door faces after forming, according to coating manufacturer's written instructions for application, thermosetting, and minimum dry film thickness.
 - a) Color and Gloss: As selected by Architect from Manufacturer's full range of colors and glosses.

2.3 TRACKS, SUPPORTS, AND ACCESSORIES

- a. Tracks: Provide manufacturer's high-lift, galvanized steel track system, sized for door size and weight, designed for lift type indicated and clearances shown, and complying with ASTM A 653, for minimum G60 zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track at 2 inches o.c. for door-drop safety device. Slope tracks at proper angle from vertical or otherwise design to ensure tight closure at jambs when door unit is closed. Weld or bolt to track supports.
- b. Track Reinforcement and Supports: Provide galvanized steel track reinforcement and support members, complying with ASTM A 36 and ASTM A 123. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
- c. Support and attach tracks to opening jambs with continuous angle welded to tracks and attached to wall. Support horizontal (ceiling) tracks with continuous angle welded to track and supported by laterally braced attachments to overhead structural members at curve and end of tracks.
- d. Weatherseals: Provide replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible rubber or neoprene fitted to bottom and at top of overhead door.
 - 1) Provide motor-operated doors with combination bottom weatherseal and sensor edge.
 - 2) In addition, provide continuous flexible seals at door jambs for a weathertight installation.

- e. Windows: Provide windows of type and size indicated and in arrangement shown. Set glazing in rubber or neoprene glazing channel for metal-framed doors. Provide removable stops of same material as door section frames.
 - 1) Size: Manufacturer's standard panel for type of glazing indicated.
 - 2) Glass: 3/4" Double pane (insulated), tinted and tempered, smooth and polished.

2.4 HARDWARE

- a. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- b. Hinges: Provide heavy-duty galvanized steel hinges, of not less than 0.0747-inch-thick uncoated steel, at each end stile and at each intermediate stile, per manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges, where required, for doors exceeding 16 feet in width, unless otherwise recommended by door manufacturer.
- c. Rollers: Provide heavy-duty rollers, with steel ball bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch diameter roller tires for 3-inch track, 2-inch diameter roller tires for 2-inch track, and as follows:
 - 1) Case-hardened steel tires.
- d. Slide Bolt: Fabricate with side locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
- e. Where door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.

2.5 COUNTERBALANCING MECHANISM

- a. Torsion Spring: Operation by torsion-spring counterbalance mechanism consisting of adjustable-tension torsion springs, fabricated from oil-tempered-steel wire complying with ASTM A 229, Class II, mounted on a cross-header tube or steel shaft. Connect to door with galvanized aircraft-type lift cables with cable safety factor of at least 5 to 1. Provide springs calibrated for 25,000 cycles minimum.
- b. Cable Drums: Provide cast-aluminum or gray-iron casting cable drums grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of shaft. Provide 1 additional midpoint bracket for shafts up to 16 feet long and 2 additional brackets at one-third points to support shafts more than 16 feet long, unless closer spacing is recommended by door manufacturer.
- c. Cable Safety Device: Include a spring-loaded, steel or bronze cam mounted to bottom door roller assembly on each side, designed to automatically stop door if either cable breaks.

- d. Bracket: Provide anchor support bracket, as required to connect stationary end of spring to the wall, to level shaft and prevent sag.
- e. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.6 ELECTRIC DOOR OPERATORS

- a. General: Provide electric door operator assembly of 1/2 HP capacity recommended and provided by door manufacturer for door and operational life specified, complete with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
- b. Comply with NFPA 70.
- c. Disconnect Device: Provide hand-operated disconnect or mechanism for automatically engaging sprocket-chain operator and releasing brake for emergency manual operation while disconnecting motor, without affecting timing of limit switch. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- d. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.
- e. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, ac or dc.
- f. Door-Operator Type: Provide unit consisting of electric motor and the following:
 - 1) Trolley or drawbar type, with V-belt primary drive, chain and sprocket secondary drive, and quick disconnect-release for manual operation.
- g. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors, complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction, from any position, at not less than 2/3 fps and not more than 1 fps, without exceeding nameplate ratings or considering service factor.
 - 1) Type: 208 Volt single phase, instant reversing with automatic reset thermal overload.
 - 2) Service Factor: According to NEMA MG 1, unless otherwise indicated.
 - 3) Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
 - 4) Provide open dripproof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.
- h. Remote-Control Station: Provide momentary-contact, 3-button control station with push-button controls labeled "Open," "Close," and "Stop."

- 1) Provide interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- i. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor able to protect full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
 - 1) Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a) Provide electrically actuated automatic bottom bar.
Self-Monitoring Type: Provide self-monitoring, 4-wire configured device.
- j. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

PART 3: EXECUTION

3.1 EXAMINATION

- a. Examine wall and overhead areas, including opening framing and blocking, with Installer present, for compliance with requirements for installation tolerances, clearances, and other conditions affecting performance of Work of this Section.
 - 1) Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- a. General: Install door, track, and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's written instructions, and as specified.
- b. Fasten vertical track assembly to framing at not less than 24 inches o.c. Hang horizontal track from structural overhead framing with angle or channel hangers welded and bolt fastened in place. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

3.3 ADJUSTING

- a. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.
- b. Adjust belt-driven motors as follows:
 - 1) Use adjustable motor-mounting bases for belt-driven motors.
 - 2) Align pulleys and install belts.

- 3) Tension belt according to manufacturer's written instructions.

3.4 DEMONSTRATION

- a. Startup Services: Engage a factory-authorized service representative to perform startup services and to train Owner's maintenance personnel as specified below:
 - 1) Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 2) Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 - 3) Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 - 4) Schedule training with Owner with at least 7 days' advance notice.

PART 4: SPECIAL PROVISIONS

None.

DIVISION 9

FINISHES

SECTION 09900
PAINTING & COATINGS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and applying protective coatings to all wood, masonry, and metal surfaces as specified or as shown on the drawings. As used in this section, “paint” or “painting” shall refer to the specified coating.
- b. It is the intent that all new interior and exterior exposed metal surfaces shall be painted, whether specifically designated or not, except as modified herein. Exposed shall be defined as not buried or embedded in concrete. Concrete floors will not be painted unless specifically specified or shown on the drawings.
- c. In general, the work shall include the field painting of the following:
 - 1) All exposed interior above-grade cast-in-place concrete (except floors, vaults, and treatment plant tankage).
 - 2) All above grade concrete masonry block.
 - 3) All exposed gypsum board, plaster, wood and insulation.
 - 4) All above grade or exposed piping, piping supports, including fittings, valves, couplings, flanges and other inline accessories (except stainless steel piping).
 - 5) Unless otherwise specified or shown on the drawings, the following will not require painting:
 - a) Nonmetallic materials such as glass, PVC, porcelain and plastic (FRP) except as required for architectural painting, color coding, or ultraviolet light protection of exposed PVC piping. Painting of exposed PVC piping is required for this project for the exterior PVC piping in and around the Headworks, SBR, and Equalization Basin. The exposed PVC piping inside the DAF Building does not require painting.
 - b) Prefinished architectural items such as acoustical tile, cabinets, louvers, etc.
 - c) Electrical switchgear, panels, motor control centers, etc. having a multiple-coated factor finish of baked enamel. However, where such factory finishes have been chipped or otherwise damaged during shipment and/or installation, the entire item of equipment shall be recoated.
 - d) Galvanized checkered plate, grating, grating frames and stair treads.
 - e) Non-submerged electrical conduits attached to unpainted concrete surfaces.
 - f) Nonferrous and corrosion-resistant ferrous alloys such as copper, bronze, aluminum, chromium plat, weathering steel and stainless steel, except

where:

- (1) It is required for electrical insulation between dissimilar metals.
- (2) Aluminum is in contact with concrete or masonry.
- (3) It is for purposes of color coding of piping.

- d. Cleaning and preparing the surfaces to be painted and, where required, applying of seal coat or prime coat are included under this section.
- e. A Painting Schedule appears in Part 4 of this section.

1.2 DEFINITIONS

- a. Equipment Colors: Equipment shall be meant to include the machinery or piping plus all structural supports and fasteners and attached electrical conduits. All non-submerged portions of equipment shall be painted the same color as the process piping or machinery with which it is associated.
- b. Field Painting: Unless otherwise specified herein, or directed, finish field painting shall be in two coats, although additional coats may be required for seal coating and prime coating as specified herein. Under no conditions shall priming or sealing coats be considered as one of the finish coats specified.
- c. Shop Painting: Shop painting shall be performed to the extent and as required under the various individual sections of the Specifications. It is intended generally that all exposed metal surfaces shall be given a protective shop coat of prime paint compatible with the field coating. If a prime coat of paint has not been applied in the shop, then a prime coat of paint shall be applied in the field after proper surface preparation and prior to the application of the finish coats.

1.3 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*), as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) Complete contact & company information & experience listing for the painter/subcontractor proposed for use, including CCB registration number.
 - 2) Written summary listing which products are proposed for use in which areas, and over which products and/or materials.
 - a) Failure to list where each product submitted on is proposed of use will result in the submittal being returned as incomplete.
 - 3) Manufacturer's literature.
 - 4) Color charts for all colored paints.

- 5) Color Samples The Contractor shall prepare in the presence of the Owner's Representative two color samples 12-inch square minimum for each finish coating color chosen by the Owner's Representative from color charts submitted by the Contractor.
- 6) Paint Formula If requested by the Owner's Representative, the Contractor shall submit manufacturers' complete formula for the paints which are proposed to be furnished, if different from those mentioned in the Specifications, in order that the Owner's Representative may determine that the proposed paints are equal to those specified. For this purpose the Owner's Representative may also require the submission, at Contractor's expense, of test reports from private laboratories showing results of comparable tests on the paint proposed and the paint specified.

PART 2: PRODUCTS

2.1 MATERIALS

- a. The products shall be as specified in the Painting Schedule. Materials selected for coating system for each type of surface shall be the product of a single manufacturer. Thinners, cleaners, driers and other additives shall be as recommended by the paint manufacturer of the particular coating.
- b. No lead bearing paints or coatings shall be used.
- c. All materials or products specified under this section which will come in contact with or which will be used on material or products which will come in contact with potable water shall conform to the requirements of National Sanitation Foundation Standard 61, Drinking Water System Components - Health Effects, and OAR 333-61-0087, Product Acceptability Criteria.
- d. Whenever any material or product is indicated or specified by patent or proprietary name, name of manufacturer or model number, such specification is used for the purpose of establishing a standard of quality and facilitating the description of the material or process desired. Such specification of a particular product shall not be construed as acceptability under the above listed criteria. It shall be the Contractor's responsibility to provide certification as required above or provide an equal quality product for which certification can be provided."

2.2 SURFACE PREPARATION

- a. All surfaces to be coated shall be in the proper condition to receive the specified coating before said coating is applied. Surface preparation shall be done in a workmanlike manner with the objective of obtaining a clean and dry surface. No more surface preparation shall be preformed than can be coated in a normal working day. The Owner's Representative, at his discretion, may require that all prepared surfaces be approved prior to application of coatings.
- b. Unless otherwise specified or noted on the drawings, the following surface preparation designations will be utilized for coating systems specified herein.

- 1) Concrete and Masonry: As specified under Part 3 of this section.
- 2) Metal Surfaces: All workmanship for metal surface preparation as specified shall be in strict conformance with the current Steel Structures Painting Council (SSPC) Specifications as follows:

Solvent Cleaning	SP1
Hand Tool Cleaning	SP2
Power Tool Cleaning	SP3
White Metal Blast Cleaning	SP5
Commercial Blast Cleaning	SP6
Brush Off Blast Cleaning	SP7
Pickling	SP8
Near White Blast Cleaning	SP10
- 3) Wherever the words "solvent cleaning," "hand tool cleaning," "wire brushing," "blast cleaning," or similar words of equivalent intent are used in these Specifications or in paint manufacturer's literature, they shall be understood to refer to the applicable SSPC Specifications listed above.

2.3 PAINTING SCHEDULE

- a. The painting schedule included in Part 4 of this section identifies the areas to be painted and number of coats required.

PART 3: EXECUTION

3.1 SCHEDULING OF WORK

- a. All above grade surfaces scheduled to be coated shall have complete coating systems applied prior to the installing of any surface mounted or through-wall equipment or systems, including equipment, electrical and control panels, surface mounted outlet/switch boxes, surface mounted conduit or piping, generator intake/exhaust air louver/dampers, sidewall exhaust fans, etc.
 - 1) Painting around surface mounted or through-wall equipment & systems is not an acceptable alternative.
 - 2) Touchup or repainting of surfaces damaged during subsequent construction or installation of equipment shall be performed by the Contractor prior to requesting final inspections.
- b. With the exception of walls and ceilings, field painting shall not be started for any section of the work until equipment, apparatus, and pipe for that section have been erected and tested, unless otherwise permitted by the Owner's Representative.

3.2 PRE-COAT MEETINGS

- a. The Contractor shall arrange a pre-coating meeting with the Owner's Representative or inspector prior to applying any coating systems. The foreman of the painting crew who will be the field supervisor during the paint or coating application for the work being discussed shall be in attendance at each pre-coating meeting held.

- 1) All prep work shall be completed prior to holding the pre-coating meeting, including removal of all formwork covering surfaces to be coated, completion of any grouting work at penetrations or joints, caulking/sealing, and all other work as required to ensure that surfaces are exposed for visual verification that they are ready for application of the specified coating(s).
 - 2) If various surfaces are coated during different stages of the project, additional pre-coating meeting(s) shall be scheduled prior to applying the coatings, once the surfaces to be coated is completed and prepped for the specified coating system as noted above.
- b. It shall be the Contractor's responsibility to ensure that the painting foreman is familiar with the manufacturer's recommendations for each paint/coating system and to verify compliance (*including but not limited to temperature or moisture limitations, surface preparation, time between coats, etc.*).
- 1) Any variances from specification requirements (*in order to conform with the manufacturer's recommendations*) shall be noted by the painting foreman and discussed with the Owner's Representative or inspector at this meeting.
- c. The Contractor shall remain fully responsible for the satisfactory performance of all paint or coatings.

3.3 DELIVERY, HANDLING AND STORAGE

- a. Delivery, handling and storage shall be in accordance with the requirements of Section 01350.

3.4 ENVIRONMENTAL REQUIREMENTS

- a. Manufacturer's Recommendations: The Contractor shall comply with manufacturer's recommendations as to environmental conditions under which coating systems can be applied and to all applicable OSHA requirements.
- b. Interior Painting may be done only when the building has been thoroughly dried, by natural or artificial heat, and when the work area is properly heated and ventilated, clean and as nearly dust free as possible. A room temperature of at least 60° F shall be maintained during application and until coatings are dry.
- c. Exterior Painting shall not be done during or immediately following rainy or frosty weather or when the temperature is below 50° F or likely to drop below freezing during drying period. The application of treatment while surfaces are exposed to hot sun, or when temperature is above 90° F, or likely to be during the drying period, shall be avoided.
- d. Dust: Paint shall not be applied in areas where dust is being generated.

3.5 PROTECTION OF SURFACES NOT SCHEDULED TO BE PAINTED

- a. During the construction period, all electrical and mechanical equipment and other equipment and apparatus shall be protected from mortar, concrete and paint drippings by means of tarpaulins, burlap, wooden housings or other protection.

- b. Finished work of other trades, surfaces not being painted concurrently or not to be painted, and metal of factory equipment that will not require field painting shall be protected at all times from paint spots and damage to the finish.

3.6 PREPARATION OF SURFACES

- a. General: All surfaces, of whatever material, which are to be painted shall be thoroughly cleaned of dirt, grease, rust scale or other injurious substance, and at the time of application of paint, shall be clean and dry.
- b. Metal Surfaces:
 - 1) All oil, grease, welding fluxes and other surface contaminants shall be removed prior to blast cleaning.
 - 2) Surfaces which have not been shop coated shall be sandblasted or pickled prior to any prime coats. Sandblasting shall be done in accordance with SSPC Specification SP10, Near White Blast Cleaning.
 - 3) Surfaces with defective shop primer shall have all loose material removed to the satisfaction of the Owner's Representative and shall be spot primed.
 - 4) Abrasions on shop coated surfaces shall be spot primed.
 - 5) Surfaces which are to receive high heat paint shall be sandblasted to bare metal (SP10) and painted within the same day and prior to any corrosion forming the prepared surface.
- c. Concrete and Masonry Surfaces:
 - 1) New concrete or masonry surfaces shall be allowed to become completely set and hard and, immediately prior to coating, shall be thoroughly cleaned of all dirt, dust, loose mortar or grout, laitance, effervesce, grease and stains.
 - 2) Efflorescence Removal. Any efflorescence present on concrete, CMU block or mortar shall be removed prior to installation of any primers or other coating systems (*either by use of pressurized water, stiff/wire brushing, or with a solution designed for this purpose*).
 - a) If chemicals are used for efflorescence removal (*including but not limited to dilute acid solutions*), all other surfaces (*including floors*) and equipment shall be covered and protected from damage from the chemical solutions.
 - 3) pH Neutralization. Concrete, CMU or other masonry surfaces shall be coated with a concrete & masonry primer/sealer designed specifically for sealing & conditioning new above-grade concrete & masonry surfaces (*ie. formulated specifically to tolerate the high pH common to new concrete or masonry and to ensure adhesion, uniform look and long-lasting finish*).
- d. Wood Surfaces shall be sanded smooth and filled with an approved paste or liquid grain

filler, and cracks and crevices shall be filled with a nonshrink, elastic composition especially prepared for this purpose. Wood surfaces to be finished with clear or translucent finishes shall be sanded smooth after being coated with a clear sealer compatible with the specified top coat.

- e. Clean up all debris from the surface preparation operation.

3.7 MIXING

- a. Paints shall be thoroughly mixed before using by pouring off top liquid in another container, stirring, and boxing the total contents several times. Paints shall be kept stirred while using, and shall be used without the addition of drier or thinner of any kind other than herein specified to be added by the manufacturer.

3.8 APPLICATION

- a. Paints and coatings shall be applied by spray, brush and/or roller in strict conformance with the manufacturer's specifications. Paint may be applied by rollers when specifically recommended by the paint manufacturer.
- b. Coverage shall be in conformance with the manufacturer's instructions. Any variation in the dry mil thickness of coatings shall be as called for under the Painting Schedule of this section but in no instance shall thickness of coatings be less than that recommended by the paint manufacturer.
- c. On metal surfaces, each coat shall be applied at the rate specified by the manufacturer to achieve the dry film thickness specified herein. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. Deficiencies in film thickness shall be corrected by the application of additional coats as required.
- d. On concrete, masonry or wood, application rates will vary according to the surface texture. However, in no case shall the specified coverage rate be exceeded. On porous surfaces, it shall be the Contractor's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats.
- e. Unless otherwise approved by the Owner's Representative based on manufacturer's recommendations (*based on actual substrate temperatures or shorter time between coats required by the manufacturer*), drying time between coats shall be a minimum of 24 hours.
- f. Application of paint by spraying may be permitted in locations and on surfaces approved by the Owner's Representative. The Contractor must submit for approval a written request giving the proposed locations of and the paint manufacturer's instructions for spray application.
- g. Paint for all metal surfaces shall be well rubbed or forced into the metal or undercoats of paint by suitable stiff, round or oval brushes, bridled if the bristles are too long or flexible. Flat brushes, when allowed, shall not be wider than 4-inches.

3.9 FIELD QUALITY CONTROL

- a. Thickness: The Contractor shall furnish the Owner's Representative a suitable thickness detector of a type recommended by the paint/coating manufacturer.
- b. Undercoats of tinted products shall be of approximate shade of final coat; however, each coat shall be of a slightly different tint. Each coat shall be inspected and approved before the next coat may be applied; otherwise, credit will not be given and the work shall be recoated.

3.10 PATCHING AND REPAIRS

- a. Any field painting found to be defective shall be removed and the surfaces repainted as the Owner's Representative may direct.
- b. Before final approval of the work all damaged surfaces of paint (field or factory applied) shall be cleaned and repainted or touched up as directed.

3.11 MARRED EXISTING FINISHES

- a. Existing buildings, pipelines, plumbing, etc., marred during construction by the Contractor shall be repainted to match the existing paint. Repainting shall be carried far enough to match the newly painted area with the existing paint.
- b. Surface preparation shall meet SP2 or SP3. Surfaces shall receive a primer and finish coats in accordance with the Painting Schedule.

3.12 PAINTING OF EXISTING EQUIPMENT AND STRUCTURES

- a. All interior concrete and masonry block surfaces to be repainted shall be cleaned of all dirt, grease, oil and loose paint in accordance with SSPC SP2. After such cleaning, the surfaces shall be given coated as outlined in Part 4.
- b. Nongalvanized ferrous metal surfaces to be repainted shall be cleaned of all dirt, grease, oil, and loose paint in accordance with SSPC SP2. Areas which have loose rust scale shall be cleaned in accordance with SSPC SP3. Rusted areas shall be treated with phosphoric acid and along with all other areas of bare metal shall be given a prime coat as specified for similar new material. The entire surface shall receive the field finish specified for new ferrous metals.
- c. All other surfaces to be repainted shall be prepared in accordance with SSPC SP2. These surfaces shall be repainted as specified for similar new materials.

PART 4: SPECIAL PROVISIONS

4.1 SCHEDULE OF COATINGS

SCHEDULE OF COATINGS				
Location	Coating	Generic Type	Minimum Dry Film Thickness, each coat	Number of Coats ¹
-Headworks, SBR, and Equalization Basin Concrete Surfaces	No coating required			
-Exterior Masonry Block, All Surfaces (clear sealant), including exposed portion of foundation to 4" below grade **Mockup coating required first.	<u>Prime & Finish Coat.</u> GE 3101 Optic Clear Translucent Silicone Coating	High solids, silicone elastomeric, waterproof anti-graffiti coating	7 mils wet, 5 mils dry	2
Interior Smooth Face Masonry Block ¹	<u>Primer</u> Sherwin Williams Primer/Block Filler: Loxon Acrylic Block Surfacer LX01W0200	100% Acrylic Resin	50-100 sq ft/gal Spray & Backroll (as req'd to fill all voids & pinholes)	2
	<u>Finish Coat</u> Sherwin Williams Macropoxy 646 FC Epoxy	Epoxy Polyamine	4.0-8.0 mils dft/ct	2
Exterior Hardy Plank Siding & HardiTrim	<u>Primer</u> Sherwin Williams Loxon Concrete and Masonry Primer-Sealer LX02W0050	100% Acrylic Resin Efflorescence Resistant	200 sq ft/gal/ct	2
	<u>Finish Coat</u> Sherwin Williams Duration Exterior Latex Satin Coating K33 Series	Acrylic Permalast	250-300 sq ft/gal	2
Exterior Wood & Wood Trim	<u>Primer</u> Sherwin Williams Extreme Block Stain Blocking Primer-Sealer B49W00600	Alkyd	350-400 sq ft/gal	1
	<u>Finish Coat</u> Sherwin Williams Duration Exterior Latex Satin Coating K33 Series	Acrylic Permalast	250-300 sq ft/gal	2
Interior soffit panels, Plywood & Interior Trim	<u>Primer</u> Sherwin Williams ProBlock Interior Oil Based Primer B79W08810	Alkyd	350-400 sq ft/gal	1
	<u>Finish Coat</u> Sherwin Williams Pro Industrial DTM Acrylic Semi-Gloss B66-200 Series	100% Acrylic	2.5-4.0 mils dft/ct	2
	<u>Finish Coat</u> Sherwin Williams ProMar 200 Sero VOC Interior Latex Semi-Gloss	Latex	350-400 sq ft/gal 1.6 mils dft	2

SCHEDULE OF COATINGS				
Location	Coating	Generic Type	Minimum Dry Film Thickness, each coat	Number of Coats ¹
Hollow Metal Doors Note: Factory Primer must be abraded prior to applying field prime coat.	<u>Primer: (Field Primer)</u> Sherwin Williams Macropoxy 646 FC	Polyamide Epoxy	4-6 mils	
	<u>Finish Coat</u> Sherwin Williams Acrolon 218 HS	Modified Polyester Aliphatic Acrylic	3-6 mils	1
All exposed metal, piping, valve bodies, pipe stands, pump discharge head, etc. not in contact with potable water. (Non-immersion service, excluding galvanized, stainless steel or fusion bond epoxy coated).	<u>Primer</u> Sherwin Williams Macropoxy 646FC	Polyamide Epoxy	4-6 mils	1
	<u>Finish Coat</u> Sherwin Williams Macropoxy 646FC	Polyamide Epoxy	4-6 mils	1
	<u>Finish Coat</u> Sherwin Williams SherPlate 600	Polyamide Epoxy NSF 61 Approved	4-6 mils	1
Exterior exposed PVC piping	<u>Primer</u> Tnemec Series 66 Hi-Build Epoxoline	Polymide Epoxy	2-3 mils	1
	<u>Finish Coat</u> Tnemec Series 73 Endura Shield	Aliphatic Acrylic Polyurethane	2-3 mils	1
¹ Number of coats shown is the minimum required for each location and type of coating. Additional coats shall be provided at no cost to the Owner to address incomplete coverage, pinholes in paint covering (<i>including but not limited to CMU block</i>), bleed-through, etc.				

NOTE: Color selection shall be by Owner from color samples supplied by Contractor prior to construction.

DIVISION 10

SPECIALTIES

SECTION 10522
FIRE EXTINGUISHERS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing portable fire extinguisher(s).

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*), as well as marking these on the applicable submittal page(s).
- b. The Contractor shall submit complete descriptive literature from the manufacturer for each type of fire fighting device used. A complete list of all appurtenances, materials involved and a general arrangement drawing shall be included.
- c. The Contractor shall submit all information required for the Operation and Maintenance Manual.

PART 2: PRODUCTS

2.1 GENERAL

- a. All fire fighting devices shall be in accordance with OSHA Standards found in Part 1910, Subpart L, "Fire Protection."
- b. All devices shall be listed by Underwriter's laboratories and approved by Factory Mutual.

2.2 PORTABLE WALL-MOUNT HIGH PERFORMANCE FIRE EXTINGUISHER

- a. Portable stored pressure high performance fire extinguisher shall have multi-purpose dry chemical extinguishing agent and the capability of fighting Class A, B and C fires.
- b. The fire extinguisher shall conform to or exceed an Underwriter's Laboratory classification of 10A-120B:C, and shall have a minimum capacity of 20 pounds of chemicals.
- c. Each fire extinguishers shall be supplied with a wall hanger bracket unless otherwise specifically noted or shown in the drawings.
- d. Each fire extinguisher shall have a tag indicating the date on which the fire extinguisher was checked and certified/serviced.
- e. The portable fire extinguisher shall have a painted steel cylinder, Amerex Model 564HPFF 20lb ABC Dry Chemical High Performance Fire Extinguisher, or equal.

PART 3: EXECUTION

3.1 INSTALLATION

- a. Mounting & installation shall conform with the Oregon Fire Code, and meet clearances required by other codes.
- b. Fire extinguishers shall be furnished and installed where indicated on the drawings.
- c. One fire extinguisher shall be provided for each room in each building whether shown on the drawings or not. At a minimum, 6 fire extinguishers shall be provided for this project. If not shown on the plans, the fire extinguishers shall be mounted where directed by the Owner's Representative.

PART 4: SPECIAL PROVISIONS

None.

SECTION 10702
SIGNS, NAMEPLATES AND TAGS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing all labor, materials, equipment and incidentals required to provide and install identification devices as shown and specified.
- b. This section includes all identification devices as specified or as shown on the drawings with the exception of electrical identification tags and markings specified in Division 13 and/or 16 or shown/noted on the electrical drawings.
- c. The types of identification devices shall include but not be limited to the following:
 - 1) Signs:
 - a) Safety signs (Danger, Caution, Warning)
 - b) Fire extinguisher location signs
 - c) Information signs (Notice)
 - d) Exit signs
 - e) Door signs
 - f) Hazardous material signs
 - g) Staff gauges
 - 2) Tags:
 - a) Valve tags
 - b) Equipment identification nameplates
 - 3) Process Piping Identification:
 - a) Contents and flow direction
- d. A Sign Schedule is included in Part 4 of this section.

1.2 QUALITY ASSURANCE

- a. Contractor is responsible for all field measurements to ensure the proper fitting of the work and use of the correct anchoring device.

1.3 SUBMITTALS

- a. American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item).
- b. Submittals shall be in accordance with the requirements of the Contract Documents and shall include:
 - 1) Shop drawings or manufacturer's cut sheets of all signs, tags, and pipe identification markers. Submittals shall be drawn to scale. Dimensions shall be shown on the drawings.

- 2) Color and material samples.
- 3) Anchorage and accessory items.

PART 2: PRODUCTS

2.1 SIGNS

- a. Unless otherwise specified or shown on the drawings (e.g., detail 5 drawing M503), all safety, fire extinguisher and informational signs shall be 0.032-inch aluminum with a baked enamel finish, minimum 7" x 10" in size, appropriate mounting holes or anchoring device as required, single faced and appropriate for indoor or outdoor use.
- b. All signs shall be furnished with rounded or blunt corners and shall be free from sharp edges, burrs, splinters, or other sharp projections. The ends or heads of bolts or other fastening devices shall be located in such a way that they do not constitute a hazard.
- c. Accident Prevention Signs and Tags: Signs shall have background colors and contrasting colors and letter sizes per OSHA regulations. Signs to conform to OSHA Safety and Health Standards - General Industry (29 CFR 1910), Subpart J - General Environmental Controls, Section 1910.145 Specifications for accident prevention signs and tags. If there is a conflict between current OSHA requirements and the specifications herein, the OSHA requirements shall control.
 - 1) Danger Signs. There shall be no variation in the type of design of signs posted to warn of specific dangers and radiation hazards.
 - a) Danger signs shall have backgrounds and lettering as outlined below:
 - (1) Top: Red oval on a black background with the word "DANGER" in white block letters in the red oval.
 - (2) Bottom: White background with black block letters. Wording shall be as listed below with letter sizes as appropriate for each sign and as specified on the sign schedule in Part 4 of this section..
 - 2) Caution Signs: Caution signs shall be used only to warn against potential hazards or to caution against unsafe practices.
 - a) Caution signs shall have a yellow background with panels and lettering as outlined below:
 - (1) Top: Black panel on top 1/3 of sign with the word "CAUTION" in yellow block letters in the panel.
 - (2) Bottom: Black block letters with wording as listed below with letter sizes as appropriate for each sign and as specified on the sign schedule in Part 4 of this section.

3) Notice Signs:

- a) Notice signs shall have a white background with panels and lettering as outlined below:
 - (1) Top: Blue panel on top 1/3 with the word "NOTICE" in white block letters in the panel.
 - (2) Bottom: Blue block letters with wording as listed below with letter sizes as appropriate for each sign and as specified on the sign schedule in Part 4 of this section..
- b) Perimeter Fence Notice Signs: Perimeter fence notice signs be of the size shown on the drawings, or with a minimum size of 10" x 14" where not listed on the drawings. Wording shall be as specified on the sign schedule in Part 4 of this section.

d. Fire Extinguisher Signs:

- 1) Fire extinguisher signs shall have a red background with the words "FIRE EXTINGUISHER" in white block letters.

e. Tank Number Signs:

- 1) The sodium hydroxide tank number signs shall be approximately inches tall by 6 inches wide and shall be suitable for mounting to the concrete housekeeping pads for each tank as shown on the drawings.

f. Door Signs:

- 1) Door signs shall be laminated thermoset plastic, minimum 1/16-inch thick and 2" x 12" in size with beveled front edges. Signs shall be provided with a pressure sensitive adhesive backing.
- 2) Lettering shall be engraved condensed 1-inch high block white lettering on contrasting background.
- 3) Background color shall be selected by the Owner from the color samples or charts submitted by the Contractor.

g. Hazardous Materials Signs:

- 1) Unless otherwise specified or shown on the drawings, all safety, fire extinguisher and informational signs shall be 20 gauge steel or 0.032-inch aluminum with a baked enamel finish, minimum 10-3/4" x 10-3/4" in size, appropriate mounting holes or anchoring device as required, single faced and appropriate for indoor or outdoor use.
- 2) Signs shall have background colors and contrasting colors and letter sizes per OSHA regulations. Signs to conform to OSHA specifications of the Hazardous Material Regulations 40 CFR Part 172.500 as amended.

2.2 NAMEPLATES AND TAGS

- a. Unless otherwise specified or shown on the drawings, tags and equipment identification nameplates shall be laminated thermoset plastic, minimum 1/16-inch thick, engraved with condensed block white lettering on contrasting background and beveled front edges. Background color shall be selected by the Owner from samples or color charts submitted by the Contractor.
- b. Equipment Identification Nameplates:
 - 1) Unless otherwise specified or shown on the drawings, equipment identification nameplates shall be minimum 1" x 2-1/2" in size. Nameplates shall be attached to equipment using a durable weather resistant adhesive.
- c. Valve and Accessory Tags:
 - 1) Unless otherwise specified or shown on the drawings, valve and accessory tags shall be 2" diameter in size. Unless otherwise specified, tags shall be attached by straps through a hole in the tag.
- d. Staff Gauges
 - 1) Staff gauges shall be mounted where shown on the drawings and described in the schedule below.
 - 2) Staff gauge components shall be assembled on a 3/16" thick stainless steel plate using all stainless steel fasteners prior to mounting. Attention shall be given to not overtighten the fasteners to prevent cracking the glass coating on components.
 - 3) The staff gauge assembly shall be mounted plumb and securely to concrete walls using all stainless steel anchor bolts and accordance with the manufacturer's recommendations.
 - 4) Lagoon Supernatant Control Structures.
 - a) A staff gauge shall be mounted on each of the Cell 1 supernatant control structures at the location shown on the drawings. The gauge shall be used to measure the water depth on the upstream side of the weir.
 - b) The measurement range shall be approximately 0.5 feet to 7.5 feet with 0.5 feet set at bottom of the concrete floor on the upstream side of the weir. The bottom of the concrete structure is approximately 0.5 feet above the bottom of the lagoon floor.
 - c) Gages shall 2.5" wide. Gages shall have graduated marks every 100th of a foot with numerical marks every foot and every tenth of a foot. Gages shall not be field-cut to the lengths shown above after the application of the porcelain coating.
 - d) Staff gages shall be Style C as manufactured by Stevens Hydrological and Meteorological Systems, or approved equal.

- 5) Equalization Basin Staff Gauge
- a) A staff gauge shall be mounted in the equalization basin at the location shown on the drawings. The gauge shall be used to measure the water depth in the basin.
 - b) The measurement range shall be approximately 0.0 feet to approximately 7.5 feet with 0.0 feet set at bottom of the concrete floor.
 - c) Gages shall 2.5" wide. Gages shall have graduated marks every 100th of a foot with numerical marks every foot and every tenth of a foot. Gages shall not be field-cut to the lengths shown above after the application of the porcelain coating.
 - d) Staff gage shall be Style C as manufactured by Stevens Hydrological and Meteorological Systems, or approved equal.
- 6) Effluent Flow Meter Staff Gauge
- a) A staff gauge shall be mounted near the effluent flow measurements weir in the chlorine contact chamber at the location shown on the drawings. The gauge shall be used to measure the water depth on the upstream side of the weir.
 - b) The measurement range 0-2.06 feet, with zero feet set at the same elevation as the weir crest.
 - c) Gages shall 2.5" wide. Gages shall have graduated marks every 100th of a foot with numerical marks every foot and every tenth of a foot. Gages shall not be field-cut to the lengths shown above after the application of the porcelain coating.
 - d) All staff gages shall be Style C as manufactured by Stevens Hydrological and Meteorological Systems, or approved equal.

2.3 PROCESS PIPING IDENTIFICATION

- a. Unless otherwise specified or shown on the drawings, all exposed piping shall be identified with permanent stenciled labels for plastic pipe, or strap-on labels which wrap completely around the pipe for other piping. Background and letter colors and styles and wording for labels shall conform to ANSI A13.1 - Scheme for Identification of Piping Systems.
- b. All stencils or labels shall include direction of flow arrows.
- c. Piping labels shall be applied close to valves, meters or branches and where pipes pass through walls or floors or where noted on the schedule below. On long runs of pipe, labels and flow direction arrows shall be placed at intervals not exceeding 45 feet.
- d. Piping labels shall be Setmark or Ultra-Mark by Seton Name Plate Corp., or Wrap-Mark by Bunting, or approved equal.

PART 3: EXECUTION

3.1 INSPECTION

- a. Examine the substrates and conditions under which the devices are to be installed and notify the Owner's Representative in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- a. Install identification devices and components at the locations shown or as directed by the Owner's Representative, securely mounted with concealed theft-resistant fasteners, unless otherwise indicated. Attach signs to substrates in accordance with the manufacturer's instructions, unless otherwise shown.
- b. Install level, plumb and at the proper height. Cooperate with other trades for installation of sign units to finish surfaces. Repair or replace damaged units as directed by the Owner's Representative.

3.3 NAMEPLATES AND TAGS

- a. Equipment Identification Nameplates:
 - 1) All new equipment, control panels, etc. not specified to be stenciled or otherwise identified shall have a tag or identification nameplate attached.
 - 2) All existing equipment designated on the drawings or in the schedule in Part 4 of this section shall have a tag or identification nameplate attached.
 - 3) Notation shall be as shown on the drawings, described in the appropriate sections of the specifications or as directed by the Owner's Representative.
- b. Valve and Accessory Tags:
 - 1) All buried and exposed valves and accessories identified on the drawings or in the schedule in Part 4 of this section shall be tagged.
 - 2) For exposed valves and accessories, the tags shall be secured with self-locking nylon straps. For buried valves with valve boxes and valves with operating nut and floor box, stamp identification number into lip of valve box and attach tags with stainless steel screws to underside of valve box covers.
 - 3) Fire hydrants and lawn hydrants do not require tagging.

3.4 PROCESS PIPING IDENTIFICATION

- a. Piping labels shall be applied close to valves, meters or branches and where pipes pass through walls or floors. On long runs of pipe, labels and flow direction arrows shall be placed at intervals not exceeding 45 feet.

PART 4: SPECIAL PROVISIONS

4.1 SIGN, NAMEPLATE/TAG, PROCESS PIPING IDENTIFICATION SCHEDULES

- a. The following schedules are not guaranteed to be complete. All signs shown on the drawings or specified shall be furnished and installed by the Contractor whether or not listed in the schedules below. Wording on the schedule is abbreviated for clarity. Contractor shall provide signs with full wording as specified or shown on the drawings.

b. SIGN SCHEDULE

Sign	Quantity	Location
FIRE EXTINGUISHER	6	Adjacent to each Fire Extinguisher.
DANGER HIGH VOLTAGE	2	Next to Automatic Transfer Switch in Blower Building Electrical Room and DAF Building Electrical Room
DANGER THIS EQUIPMENT STARTS AND STOPS AUTOMATICALLY.	8	On end of each Generator Tank, near the blowers, near the SBR decanter drives, near the DAF air compressors, plus two other locations as directed by the Owner's Representative.
CAUTION WEAR EYE PROTECTION, RUBBER GLOVES AND APRON WHEN HANDLING CHEMICALS.	4	Near the polymer pump skid, near the coagulant pump skid, near the salt brine tank, and near the chlorine pump skid.
NOTICE AUTHORIZED PERSONNEL ONLY	6	All Building Exterior Doors
CAUTION EAR PROTECTION AREA	4	On doors entering the blower room and the DAF room.
DANGER CONFINED SPACE HAZARDOUS ATMOSPHERE	1	Plant pump station wet well
DANGER HIGH VOLTAGE	4	Where directed
NOTICE NON-POTABLE WATER DO NOT DRINK	10	Where directed
Lagoon water level staff gauges as specified above	2	On Cell 1 supernatant control structures
Effluent flow measurement weir staff gauge	1	Chlorine contact chamber adjacent to effluent weir.

c. NAMEPLATE AND TAG SCHEDULE: Equipment to be identified shall include but not be limited to the following:

Label/Tag	Equipment	Location
BL01	Blower #1	Blower Building
BL02	Blower #2	Blower Building
BL03	Blower #3	Blower Building
B1WSP	Basin 1 Waste Sludge Pump Disconnect Panel	SBR Basin 1
B2WSP	Basin 2 Waste Sludge Pump Disconnect Panel	SBR Basin 2
B1MIX	Basin 1 Mixer Disconnect Panel	SBR Basin 1
B2MIX	Basin 2 Mixer Disconnect Panel	SBR Basin 2
DCNT1	Basin 1 Decanter	SBR Basin 1
DCNT2	Basin 2 Decanter	SBR Basin 2
AV1	Basin 1 Air Valve	Blower Building

AV2	Basin 2 Air Valve	Blower Building
C8001	Compressor 8001	DAF Building
C8002	Compressor 8002	DAF Building
CP9301	Coagulant Pump 9301	DAF Building
CP9302	Coagulant Pump 9302	DAF Building
CP9401	Polymer Pump 9401	DAF Building
CP9402	Polymer Pump 9402	DAF Building
CLP1	Chlorine Pump 1	DAF Building
CLP2	Chlorine Pump 2	DAF Building
CLP3	Chlorine Pump 3	DAF Building

- d. PROCESS PIPING IDENTIFICATION SCHEDULE: Piping to be identified shall include but not be limited to the following:

Label	Location
COAGULANT	Wall mounted coagulant piping (minimum 4 required equally spaced)
POLYMER	Wall mounted coagulant piping (minimum 4 required equally spaced)
CHLORINE IRRIGATION PIPE	Wall mounted chlorine solution pipe to irrigation injection point in the DAF building (1 required)
CHLORINE CONTACT CHAMBER	Wall mounted chlorine solution pipe to contact chamber injection point in the DAF building (1 required)
SBR BASIN 1 AIR	SBR Basin 1 Air Pipe Inside Blower Building (1 required)
SBR BASIN 2 AIR	SBR Basin 2 Air Pipe Inside Blower Building (2 required)

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TECHNICAL SPECIFICATIONS DIVISION 11 - 16

CITY OF AUMSVILLE

Project Manual: SPECIFICATIONS AND CONTRACT DOCUMENTS

For

AUMSVILLE WASTEWATER TREATMENT PLANT IMPROVEMENTS



JO 2599.3220.0

May 2026

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See drawing Sheet G002 for sheet index of construction drawings.

DIVISION 11

EQUIPMENT AND SYSTEMS

SECTION 11160 PNEUMATIC-TIRE FORKLIFT

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes
 - 1) Furnishing and delivery of one (1) conventional pneumatic-tire forklift with a minimum 5,000 lb rated lift capacity, intended for outdoor rough-surface and compacted gravel service as specified herein.
 - 2) All standard and optional equipment, attachments, accessories, manuals, and training specified or reasonably required for safe and complete operation in an outdoor, uneven-surface environment.
- b. Intended Service Conditions
 - 1) The forklift shall be specifically suited for the following site conditions:
 - a) Outdoor operation on compacted gravel, crushed stone, and uneven unpaved surfaces typical of water and wastewater treatment plant yards and maintenance areas.
 - b) Grades up to 10% on unpaved surfaces.
 - c) Exposure to moisture, intermittent rain, dust, and chemical vapors associated with water and wastewater treatment operations.
 - d) Handling of materials including chemical drums, chemical totes, equipment pallets, pipe sections, valve assemblies, and bagged or bulk treatment chemicals.
 - e) Operation by trained plant maintenance and operations staff.
- c. Related Sections
 - 1) Section 01705 — Operation and Maintenance Manuals

1.2 SUBMITTALS

- a. Product Data: Submittals shall be in accordance with the requirements of these contract documents and shall include:

Submittals for Review:

- 1) Complete manufacturer's technical data sheets for the proposed unit, including rated capacity, rated load center, overall dimensions, turning radius, ground clearance, and tire specifications.
- 2) Manufacturer's documentation confirming the unit is rated and suitable for outdoor pneumatic-tire rough-terrain or gravel-surface operation at the specified rated capacity.
- 3) Engine emission certification confirming compliance with applicable EPA Tier 4-Final (diesel) or CARB requirements for the engine displacement class.
- 4) Deviation log identifying any variance from the basis-of-design model, with written justification demonstrating equal or better performance for outdoor rough-surface operation.
- 5) Proposed warranty documentation including terms, coverage duration, and exclusions.
- 6) Dealer qualification documentation per Paragraph 1.04.

Submittals for the Record:

Submit at time of equipment delivery:

- 7) Manufacturer's operations & maintenance instructions and warranty for all equipment items for inclusion in the O&M manuals as described in Section 01300.
- 8) Vehicle registration documents as required.
- 9) Written record of operator training session per Section 3.04.

1.3 QUALITY ASSURANCE

a. Manufacturer Qualifications

- 1) The manufacturer shall have been regularly engaged in the production of industrial forklifts for a minimum of ten (10) years, with documented product lines serving outdoor and rough-terrain applications.
- 2) Representative outdoor-service models in the 5,000 lb class shall have been in commercial production for a minimum of five (5) years with an established service and parts network.

b. Dealer Qualifications

- 1) The equipment dealer shall have continuously represented the specified manufacturer in this market for a minimum of five (5) years.
- 2) The dealer shall maintain a parts counter within a 200 mile radius of the City of Aumsville, with online ordering capability and in-person pickup during normal business hours.
- 3) The dealer shall have factory-certified field service technicians dispatched from a location within a 200 miles radius of the City of Aumsville.

c. Regulatory Compliance

- 1) All units shall comply with applicable federal, state, and local motor vehicle codes, safety standards, and emissions regulations in effect at the date of delivery.
- 2) Units shall be new, current-production models; no refurbished, reconditioned, or demonstration units will be accepted.

1.4 DELIVERY, STORAGE, AND HANDLING

a. Delivery

- 1) Prior to delivery, the Contractor shall perform the manufacturer's complete pre-delivery service. The unit shall be fully tested and operationally ready before leaving the dealer's premises.
- 2) The Owner may inspect the unit at the dealer's place of business prior to delivery to verify conformance to specifications, workmanship, appearance, and proper system operation. The Contractor shall notify the Owner's designated representative to arrange the pre-delivery inspection.
- 3) Deliver to: the City of Aumsville Wastewater Public Works Building 955 Olney Street, Aumsville, Oregon, between 8:00 a.m. and 3:30 p.m., Monday through Friday, excluding holidays. Coordinate precise delivery schedule with the City operations staff.
- 4) Equipment shall be delivered fully fueled (or charged, if electric), licensed, and registered.

b. Failure to Conform

- 1) The Owner reserves the right to reject any delivery that does not meet these specifications.

1.5 WARRANTY

a. Minimum Required Warranty.

The Contractor shall provide a minimum one (1) year / 2,000-hour comprehensive warranty covering parts and labor for all components of the unit from the date of Owner's acceptance.

b. Warranty Service Response

- 1) Equipment under warranty shall be repaired and returned to service within ten (10) working days of written notification by the Owner.
- 2) If the unit cannot be returned within ten (10) working days, the Contractor shall provide an Owner-approved loaner or replacement unit at no cost beginning on the eleventh (11th) working day.
- 3) Any unit requiring warranty repairs totaling more than fifteen (15) working days in a calendar year shall be permanently replaced by the Contractor at no cost to the Owner.

PART 2: PRODUCTS

2.1 MANUFACTURERS

a. Basis of Design — Acceptable Manufacturers

The following units are identified as acceptable basis-of-design models. All minimum specifications stated herein shall apply regardless of manufacturer or fuel type selected:

Toyota 8FDU25 (Diesel)	Toyota Material Handling, USA — or current equivalent model
Hyster H50FT (Diesel)	Hyster-Yale Group — or current equivalent model
Komatsu FG25T-16 (Diesel)	Komatsu Forklift USA — or current equivalent model
Cat DP25N (Diesel)	Cat Lift Trucks (Mitsubishi Logisnext Americas) — or current equivalent model

2.2 PERFORMANCE REQUIREMENTS

a. Rated Capacity and Load Center

Minimum Rated Capacity	5,000 lbs (2,268 kg)
Rated Load Center	24 in. (610 mm)
Service Classification	Outdoor, pneumatic-tire, rough and uneven compacted gravel surface

b. Travel Performance

Travel Speed (Unloaded)	12 mph minimum
Travel Speed (Rated Load)	10 mph minimum

Maximum Gradeability (Unloaded)	35% minimum
Maximum Gradeability (Rated Load)	20% minimum
Sustained Grade Operation	10% grade with rated load, sustained (for plant yard service)

c. Lift / Lower Performance

Lifting Speed (Unloaded)	100 fpm minimum
Lifting Speed (Rated Load)	80 fpm minimum
Lowering Speed (Rated Load)	Controlled descent; 80–120 fpm

d. Noise Level

Operator Ear Level	≤ 80 dB(A) per EN 12053 or equivalent

2.3 DIMENSIONS AND WEIGHTS

a. Key Dimensions (Minimum / Maximum — verify with Supplier)

Overall Length (to fork face)	Approximately 130–145 in. (verify with selected model)
Overall Width (over tires)	72–80 in. maximum (to fit plant access ways)
Wheelbase	approximately 60–66 in.
Overall Height (mast lowered, overhead guard)	Approximately 84–90 in.
Ground Clearance (minimum, laden)	6 in. minimum (for gravel surface clearance)
Minimum Turning Radius (outer)	110 in. maximum

2.4 POWER UNIT

a. Engine — Diesel

Fuel Type	Diesel (ULSD) — recommended for outdoor continuous-duty service
Emission Standard	EPA Tier 4-Final (required); CARB-compliant where applicable
Minimum Rated Power	75 hp (56 kW) at rated rpm
Engine Type	4-stroke, liquid-cooled, minimum 4-cylinder
Fuel Tank Capacity	13 gal. minimum
DEF / AdBlue System	Required if Tier 4-Final engine uses SCR aftertreatment; tank minimum 3 gal.
Acceptable Manufacturers	Kubota, Yanmar, Cummins, Toyota, or manufacturer's standard engine

2.5 TRANSMISSION AND DRIVETRAIN

a. Transmission

Type	Hydrostatic or hydrodynamic powershift (torque converter)
Gears — Forward / Reverse	Minimum 2F / 2R
Inching / Creep Control	Required — inching pedal or equivalent for precise load positioning on uneven ground

b. Drive Axle

Type	Solid drive axle with differential; pneumatic tire compatible
Service Brakes	Hydraulically actuated wet disc or drum brakes on drive axle; effective on gravel and uneven surfaces
Parking Brake	Spring-applied, hydraulic-release or mechanical; effective on minimum 15% grade

c. Steer Axle

Type	Oscillating rear steer axle (required for rough-surface stability)
Steering	Full hydraulic power steering
Oscillation	Rear axle shall be fully oscillating (pivot-mounted) to maintain all four tires in contact with uneven or undulating gravel surfaces

2.6 TIRES AND WHEELS

a. Tire Requirements — Outdoor / Rough-Surface Service

Tire Type	PNEUMATIC — air-inflated, multiple-ply construction (REQUIRED)
Tire Construction	Bias-ply (cross-ply) or radial; deep lug / industrial tread pattern suited for loose gravel and unpaved surfaces
Minimum Tread Pattern	Non-directional lug or traction tread; tread depth minimum 12/32 in. when new
Front Tire Size	7.00-12 minimum; 8.25-15 or 28×9-15 preferred for gravel service
Rear Tire Size	6.00-9 minimum; 6.50-10 or 21×8-9 preferred for gravel service
Ply Rating	Front: 12-ply (PR12) minimum; Rear: 10-ply (PR10) minimum
Wheel Type	Multi-piece split-rim or single-piece drop-center; suitable for field tire changes
Inflation Pressure	Per manufacturer's recommendation for rated load on pneumatic tires; marked on tire sidewall

b. Tire Performance Requirements

- 1) Tires shall maintain rated load capacity performance on compacted gravel, crushed stone, and uneven unpaved surfaces without excessive deformation or heat buildup.
- 2) Tread design shall resist stone packing and self-clean under operating conditions.
- 3) Tires shall be from a recognized industrial or OTR tire manufacturer (Bridgestone, Michelin, Solideal/Camso, Titan, Trelleborg, or approved equal).
- 4) The Contractor shall provide tire manufacturer's published load and inflation tables confirming suitability for the rated capacity at the selected tire size.

2.7 HYDRAULIC SYSTEM

System Type	Open-center or load-sensing gear pump system
Minimum Flow	Adequate for rated lift and steer performance at rated engine speed
Max Working Pressure	3,000 psi minimum rated system pressure
Hydraulic Tank	Minimum 8 gal.; vented with breather filter; accessible for service
Filtration	Suction strainer and return-line filter; minimum 10-micron return filtration
Couplings	SAE O-ring Face Seal (ORFS) or JIC; no pipe-thread hydraulic fittings
Side Shift	Hydraulic side-shift carriage required for load positioning on uneven surfaces

2.8 MAST AND LIFTING EQUIPMENT

a. Mast

Mast Type	Duplex (2-stage) with full free lift, or Triplex (3-stage) — as required for building entry clearance at facility
Minimum Lift Height	130 in. (to forks at full elevation)
Minimum Free Lift	6 in. (required for use on uneven ground without mast extension)
Mast Tilt	+5° forward / -12° backward minimum (increased back-tilt for load stability on grades and gravel)
Mast Construction	Welded structural steel; load rollers with sealed bearings suitable for outdoor environment; protected hose routing
Lowered Height	Shall pass through all facility overhead clearances — confirm with Owner (minimum 84 in. clear assumed unless noted otherwise)

b. Fork Carriage

Carriage Class	ISO Class III (per ANSI B56.1) for 5,000 lb capacity
Side Shift	Hydraulic side-shift carriage required (±4 in. each direction minimum)
Carriage Width	Standard for Class III; confirm compatibility with selected mast

c. Forks

Fork Length	48 in. standard; 60 in. available as option
Fork Width	5 in. minimum
Fork Thickness	1.75 in. minimum
Fork Taper	Standard taper per ANSI B56.1
Fork Grade	Minimum Grade T (per ANSI/ASME B56.11.6); manufacturer to certify
Mounting	Hook-type; Class III carriage

2.9 CHASSIS AND BODY

a. Chassis

- 1) Heavy-duty welded steel chassis sized for 5,000 lb capacity outdoor service.

- 2) Counterweight shall be integrally cast or welded; no bolt-on ballast plates without Engineer approval.
 - 3) Minimum 6 in. ground clearance (laden) to clear gravel surface irregularities and avoid underbelly contact.
 - 4) All undercarriage components shall be protected from gravel impingement, including hydraulic lines, brake components, and sensors.
 - 5) Tow hitch or tow pin in counterweight.
 - 6) Lifting eyes or jacking points for safe lifting of complete unit.
- b. Body and Guards
- 1) Overhead Guard (OHG): ANSI / ISO 6055 compliant, rated for the unit's load capacity class; required — no exceptions.
 - 2) Load backrest extension: Required; minimum height 42 in. above fork blade tops to retain palletized loads during travel on uneven surfaces.
 - 3) Full steel fenders over front drive tires to deflect gravel and debris from engine, operator, and mast area.
 - 4) Anti-slip surfaces on all operator access steps, running boards, and floor plate.
 - 5) Engine compartment hood with full weather sealing; lockable for security.
 - 6) Corrosion-resistant paint finish suitable for outdoor exposure; minimum 2-coat epoxy primer plus polyurethane topcoat, or powder coat equivalent.

2.10 ELECTRICAL SYSTEM

- a. System Voltage — 12V

- b. Weather Protection

All electrical components, connectors, and wiring shall be rated for continuous outdoor service. Electrical system shall conform to minimum IP54 ingress protection for exposed components.

- c. Lighting — All LED

- 1) 2 LED headlights (forward working lights) — front mounted; suitable for low-light outdoor yard operations.
- 2) 2 LED tail / brake lights — rear mounted.
- 3) 1 LED strobe or rotating warning beacon — roof or overhead guard mounted (required for outdoor yard use).
- 4) Turn signals — front and rear (required if unit will travel on paved plant roads shared with vehicles).

- d. Alarms and Safety

- 1) Multi-tone reverse travel alarm (required).
- 2) Seat-activated interlock: unit shall not move unless operator is seated and seat belt fastened.
- 3) Low fuel / low DEF warning lights and audible alert.
- 4) Engine protection system: automatic shutdown or alarm for low oil pressure, high coolant temperature.

- e. Power

- 1) 12V power outlet (cigarette-style or SAE) for accessories.
- 2) Battery: minimum 650 CCA, maintenance-free sealed type; cold-weather performance rated.

2.11 OPERATOR STATION

a. Structure

- 1) Overhead Guard (OHG): ANSI / ISO 6055 compliant; integrated into frame; meets applicable drop-test standard.
- 2) Open operator station.

b. Seat and Restraint

- 1) Adjustable suspension seat with fore-aft adjustment and weight adjustment; minimum weight range 110–265 lbs.
- 2) Lap-type seat belt, minimum 2-in. width; seat belt interlock required.
- 3) Operator presence system: machine shall not operate if operator leaves seat without setting parking brake.

c. Controls

- 1) Hydraulic fingertip or mini-levers for lift, tilt, and side-shift — ergonomic layout for extended outdoor use.
- 2) Inching / brake pedal combination for precise positioning on grades.
- 3) Steering: full hydraulic power assist; tilt-adjustable steering column preferred.
- 4) Instrument panel: hour meter, fuel gauge, engine warning lights, and transmission gear indicator as a minimum.
- 5) All controls, gauges, and switches shall be protected from direct rain exposure; weatherproof bezels or shrouding required for open-cab units.

2.12 MONITORING AND INSTRUMENTS

The following instruments and warning indicators shall be provided as a minimum:

Hour Meter	Cumulative, non-resettable; visible from operator position
Fuel Level Gauge	Required; low-fuel warning light and/or buzzer
DEF Level Gauge	Required if Tier 4-Final SCR system is fitted
Engine Coolant Temp	Warning light and/or gauge; audible alarm at high temperature
Engine Oil Pressure	Warning light; audible alarm at low pressure
Hydraulic Oil Temp	Warning light at high temperature
Battery / Charging	Alternator charging warning light
Parking Brake	Indicator light
Air Filter Restriction	Warning indicator (outdoor operation generates elevated dust)

2.13 DOCUMENTATION AND DECALS

a. Each unit shall be supplied with, as a minimum:

- 1) Load capacity chart inside operator station and on mast or overhead guard
- 2) Machine specification plate on chassis
- 3) Warning, tire pressure, and fluid specification decals
- 4) Control identification decals for all levers and switches
- 5) Printed Operator's Manual (weatherproof holder mounted on machine)

- 6) Maintenance Manual (printed and PDF)
- 7) Parts Catalog (printed and PDF)
- 8) Service / Workshop Manual (PDF acceptable)

2.14 ACCESSORIES

- a. The forklift shall be provided with a drum grabber designed to handle 55 gallon chemical drums. Drum grabber shall be Uline mode H7170 Universal Drum Grabber, or approved equal.

PART 3: EXECUTION

3.1 EXAMINATION

- a. Pre-Delivery Inspection
 - 1) The Owner reserves the right to inspect the unit at the Contractor's place of business prior to delivery to verify conformance to these specifications, workmanship, appearance, and proper functioning of all systems.
 - 2) The Contractor shall notify the Owner's designated representative to schedule the pre-delivery inspection.
 - 3) The Owner's pre-delivery inspection constitutes acceptance for delivery purposes only; it does not constitute final acceptance or waiver of any warranty rights.

3.2 PREPARATION

- a. Pre-Delivery Service
 - 1) Prior to delivery, the Contractor shall perform the manufacturer's complete standard pre-delivery service, including all fluid checks and top-offs (engine oil, coolant, hydraulic oil, DEF if applicable, brake fluid, and gear oil), tire inflation to manufacturer's recommended pressure, lubrication of all grease points, and full operational function verification.
 - 2) The unit shall be delivered fully fueled and operationally ready.
 - 3) Tire inflation shall be set to the manufacturer's recommended pressure for the rated capacity and the tire size installed; inflation pressure shall be verified and recorded on the pre-delivery service sheet.
- b. Licensing and Registration
 - 1) Vehicle registration shall be completed by the Contractor / dealer prior to delivery per applicable state and local requirements.
 - 2) CARB EIN documentation (where applicable) shall be provided to the Owner at delivery.

3.3 INSTALLATION — DELIVERY

- a. Delivery
 - 1) Deliver the equipment to the Owner's designated receiving area. Delivery shall occur between 8:00 a.m. and 3:30 p.m., Monday through Friday, excluding Owner holidays.
 - 2) Coordinate the precise delivery time with the Owner's Equipment Supervisor no less than [48] hours before delivery.

- 3) Upon delivery, the Contractor's representative shall fully demonstrate all systems and controls to the Owner's representative, including a graded-surface and gravel-surface travel test if site conditions permit.
- b. Manuals
- 1) One (1) complete set of printed operating instructions, parts books, and service / repair manuals shall be furnished at the time of delivery. Payment will not be rendered until manuals are received and confirmed complete.
 - 2) Printed Operator's Manual shall be secured in a weather-resistant holder permanently mounted on the machine. Location to be approved by Owner.

3.4 DEMONSTRATION AND TRAINING

- a. Operator and Maintenance Training
- 1) The Contractor shall provide a minimum of four (4) hours of basic operator and maintenance training at the Owner's facility, conducted by a factory-certified or dealer-certified representative.
 - 2) Training shall cover, as a minimum: pre-operation inspection checklist; safe operating procedures per OSHA 29 CFR 1910.178; operation on grades, gravel surfaces, and uneven terrain; correct loading and traveling posture on slopes; refueling, DEF servicing (if applicable), and tire pressure checking procedures; daily and periodic maintenance; hydraulic side-shift operation; and emergency and lockout/tagout procedures.
 - 3) The Contractor shall provide a written training record including date, attendees, and topics covered, and submit this record as a closeout document to the Owner.

3.5 FIELD QUALITY CONTROL

- a. Acceptance Testing
- 1) Upon delivery, the Owner's representative shall verify conformance to these specifications. Non-conforming equipment shall be rejected.
 - 2) Tire inflation pressure shall be verified by the Owner's representative at delivery using a calibrated gauge.
- b. Non-Conforming Work
- 1) Equipment not meeting specifications shall be corrected or replaced by the Contractor at no cost to the Owner. Resubmittal for inspection shall occur within [14] calendar days of rejection notice.

SECTION 11240
CHEMICAL FEED EQUIPMENT

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing and installation of chemical feed equipment and piping, complete and ready for operation. This section does not include the polymer and coagulant chemical feed pump skids. These skids are included in the DAF equipment package. This section does include the containment pallets for the polymer and coagulant feed systems.
- b. All work performed under this section shall comply and be in accordance with approved trade practices and manufacturer's recommendations.
- c. To assure intercompatibility of equipment and provide system responsibility, all equipment items in this section shall be provided by one supplier.
- d. Systems installed and, or supplied under this section include:
 - 1) 1 - onsite chlorine generation system and supporting equipment.
 - 2) 1 – gas feed sulfur dioxide feed system and supporting equipment.
 - 3) 1 – non-potable water supply pump system for supplying carrier water to the sulfur dioxide feed systems.
 - 4) 1 – drain pump for to drain the chlorine contact chamber.
 - 5) Containment pallets for the DAF system polymer and coagulant storage areas.

1.2 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) For Review
 - a) Descriptive literature, bulletins or other data describing the system equipment.
 - b) Seismic restraint calculations for the sodium hydroxide storage tanks.
 - c) Complete list of equipment and appurtenances included, complete, with manufacturer's name and model number.
 - d) General arrangement and dimension drawings including anchor bolt layout
 - e) Pump skid layout drawings and sulfur dioxide injector panel layout drawings.
 - f) Sectional assembly drawings.

- g) Materials of construction.
 - h) Certified capacity data.
 - i) Bill of Materials.
 - j) Process and Instrumentation Diagrams
 - k) Motor Data for all Motors
 - l) Wiring Diagrams for all field wiring
- 2) O&M Manuals - Operations and Maintenance information, including parts lists and complete manufacturer's literature for each piece of equipment, shall be submitted for all materials and equipment furnished under this and related sections. O&M manuals shall be in accordance with Section 01300 of these contract documents.

1.3 PIPE SUPPORTS

- a. The Contractor shall furnish and install all pipe supports and inserts required to support properly the piping and valves. Unless otherwise shown on the drawings, supports shall be designed and spaced to secure pipe in place without sag or undue stress on any pipe, fitting, equipment or valve. Piping that is close to the floor may be supported by wall brackets. Piping at equipment and valves, etc., shall be supported so that the equipment and valves can be removed without additional pipe supports. All pipe supports shall be stainless steel.

1.4 DRAWINGS

- a. All drawings are diagrammatic and are intended to show the approximate location of equipment and piping. Dimensions given on the plans shall take precedence over scaled dimensions and all dimensions whether in figures or scaled, shall be verified in the field.
- b. The exact location of apparatus, fixtures, equipment, and piping shall be ascertained by the Contractor in the field, and the work shall be laid out accordingly. Should the Contractor fail to ascertain such locations, the work shall be changed at his own expense when so ordered by the Engineer. The Engineer reserves the right to make minor changes in the location of piping and equipment up to the time of installation without additional cost to Owner.
- c. Contractor shall maintain at least one set of prints at the job site with all revisions and field changes up to date. At the completion of the Contractor's portion of the work, one complete set of corrected construction drawings shall be forwarded to the Engineer.

PART 2: PRODUCTS

2.1 GENERAL

- a. All ferrous equipment shall be provided with a standard corrosion resistant factory finish coat compatible with the conditions of service.
- b. All piping shall be installed in a manner that does not interfere with easy access and egress to the gas handling equipment.
- c. Warranty service shall be available through factory authorized dealers or service contractors within a 250 mile radius of the installation.
- d. All products specified herein shall be provided, and tested by a single vendor to provide a completely integrated fully functional system. The vendor shall maintain service facilities within 250 miles of the project site and have at least 10 years of experience in providing and servicing the equipment items provided. Qualified vendors include TMG Services, Tacoma, WA.

2.2 ONSITE CHLORINE GENERATION SYSTEM

a. General

- 1) The Contractor shall furnish an On-Site Hypochlorite Generation System to enable on-site production of a 0.8% (+/- 0.05%) sodium hypochlorite solution through the electrolysis of brine.
- 2) Production of the sodium hypochlorite solution shall be automatic and on-demand, utilizing solar grade salt, water, and electrical power to produce a <1.0% hypochlorite solution.
- 3) The total generation capacity shall be achieved using one (1) integrated skid. The skid shall be capable of producing 65 pounds per day (1.25 kg/hr) using only one (1) electrolyzer cell.
- 4) All the components of the skid shall be furnished pre-piped, pre-wired and pre-mounted on an engineered frame. As a minimum, each skid provided shall include the following components:
 - a) Water Softener
 - b) Transformer/rectifier
 - c) Brine Feed Pump
 - d) Electrolyzer Assemblies
 - e) System Control Panel
 - f) Engineered Frame System
 - g) Dilution Water Controls
 - h) Water Heaters and or Chillers (if required)
- 5) The skid shall be a ready-to-use and factory tested unit. Only the following connections shall be required:
 - a) Brine Inlet: 1/2" NPT (DN 15) from Brine Tank
 - b) Potable Water Inlet: 3/4" NPT (DN 20) from Plant Water Supply
 - c) Soft Water Outlet: 1/2" NPT (DN 15) to Brine Tank
 - d) Softener Waste Drain: 1/2" NPT (DN 15) to Sanitary Drain
 - e) Hypochlorite Outlet: 1-1/4" NPT (DN 32) to Hypochlorite Tank
 - f) Power to Control Panel and Rectifier: 480V 3PH 60Hz

- g) Discrete or Communicated Signal wiring with Plant Equipment
- 6) In addition to the skid, the Contractor shall furnish the following ancillary components required for a fully operational system including:
 - a) One (1) Acid Cleaning System
 - b) One (1) Brine Saturator Tank with Level Instrumentation
 - c) One (1) Sodium Hypochlorite Tank with Level Instrumentation
 - d) One (1) Hydrogen Blower
 - e) One (1) Hydrogen Leak Detector
- 7) The Contractor shall provide the services of a qualified manufacturer's representative to complete the following, to ensure the safe and efficient operation of the system:
 - a) Commissioning and installation inspection
 - b) System startup services
 - c) System testing supervision
 - d) Operator training
- 8) The Contractor shall furnish all labor, materials, equipment and appurtenances required to install, test and place into satisfactory operation the onsite chlorine generation system, including, but not limited to:
 - a) Mechanical installation of external components, interconnecting piping, piping supports, fittings, valves and appurtenances.
 - b) Electrical installation of external components, circuit breakers, transformers, raceways, fittings, conduits and cable trays, wires and cables, panel boards, metering devices, grounding systems, power factor correction capacitors and surge protection.
- 9) Special Warranty.
 - a) In addition to the 12 month Warranty for the entire installation, The anode plates shall be warranted for a period of 7 years as follows:
 - (1) The anode warranty shall cover the full anode replacement cost for the first 2 years of operation.
 - (2) The anode warranty shall cover the anode replacement cost on a prorated basis from the 3rd to the 7th year of operation.

b. Quality Assurance

- 1) All components shall be by a single manufacturer.
- 2) The manufacturer shall have at least twenty (20) years experience in furnishing and servicing on-site electrolytic hypochlorite generation systems of similar capacity to the equipment specified herein. As part of their submittal package, the supplier shall submit following documentation:
- 3) Evidence that hypochlorite generators of similar capacity have been in successful operation for at least two (2) years in at least five (5) separate installations. Provide location of installation, contact person name and phone number, capacity of generation system and year installed.

- 4) Provide local service technicians resumes that are factory trained and located within 4 hours of the project site.

c. Approved Equipment:

- 1) The onsite chlorine generation system shall be a B-PAK 65 as manufactured by Wallace & Tiernan or approved equal.

d. Hypochlorite Generation Skid

- 1) Functional Requirements
 - a) Except for the brine saturator tank, hypochlorite storage tank, hydrogen dilution blower(s), power rectifier, each generation skid shall include all the components required to safely operate the hypochlorite generation system.
 - b) The skid design shall allow for maintenance access for every component without the need to remove other components.
 - c) The skid shall include all valves, instruments and accessories necessary to reduce the brine concentration from 26% to 3% (by weight).
- 2) Materials
 - a) The skid base shall be corrosion resistant epoxy painted steel with a with high-density polyethylene top cover.
 - b) Equipment and piping support shall be corrosion resistant epoxy coated steel.
 - c) All interconnecting piping shall be schedule 80 PVC.
- 3) Features
 - a) The skid shall have a maximum footprint of 67" L x 30" W (1690 x 750 mm)
 - b) The skid shall weigh no more than 995 pounds (450kg)
 - c) The skid shall meet seismic zone requirements for Aumsville Oregon.
 - d) The skid shall include the following instruments and accessories:
 - (1) One (1) water flow meter
 - (2) One (1) water safety solenoid valve activated on hi-hi tank level
 - (3) Two (2) water flow control valves, self-adjusting orifice type.
 - (4) One (1) brine back pressure valve
 - (5) One (1) brine flow meter
 - (6) One (1) electrolyzer outlet temperature sensor
 - (7) One (1) electrolyzer inlet temperature sensor
 - (8) Valve for product sampling
 - (9) Hydraulic connection for acid cleaning and draining of cell
 - (10) Electrical connection for control of acid cleaning system

e. Water Softener

- 1) Functional Requirements
 - a) The onsite chlorine generation skid shall be equipped with a water softener through which water will initially pass to reduce the potential of hardness fouling of electrode surfaces inside the electrolyzer cells. The

softened water shall be dispensed to both brine saturator tank and hypochlorite generator.

- b) One water softener must be supplied for each hypochlorite generator. Each water softener shall be sized to reduce the hardness to < 17 mg/L as CaCO₃ for a minimum flow rate of 30 gpm.
- c) The softeners shall be appropriate for continuous use with water of the following quality:
 - (1) Water pressure: 30 to 70 psi
 - (2) Water temperature (min – max): 45 to 65 degrees F
 - (3) Water pH: 6 to 9
 - (4) Water hardness mg/L as CaCO₃: Approximately 50
 - (5) Chlorine residual: 2 mg/L (max)
- d) Each softener shall ensure uninterrupted supply of softened water. The softener shall include two-(2) tanks (dual bed) and not be designed to operate in overdrive. Regeneration of one pair of tanks shall be accomplished while the other pair of tanks is in use.
- e) The regeneration cycle shall be based on water flow; electric timers and gear motors are not acceptable. The regeneration cycle should last a maximum of 90 minutes, and consume a maximum of 142 gallons of saturated brine.
- f) Each softener shall use brine from the saturator tank for the regeneration cycle. The regeneration waste shall be disposed to a sanitary drain.

2) Materials

- a) The softener vessels material shall be engineered plastic.
- b) The softener flow meter shall have a polypropylene turbine.
- c) Softener connections shall be PVC.

3) Features

- a) The softener shall not require electrical power to operate.
- b) The softener shall be located on the skid
- c) The softener vessels shall be designed for 125 psig max. working pressure and hydrostatically tested @ 300 psig.
- d) Vessels shall be NSF approved

4) Manufacturer

- a) The water softener shall be NSF61 - Kinetico model CP213sOD or approved equal.

f. Brine Feed Pump

1) Functional Requirements

- a) The saturated brine shall be pumped from the brine saturator tank to each hypochlorite generator at a constant flow rate to ensure stable and efficient production of sodium hypochlorite.
- b) One (1) brine feed pump shall be furnished for each hypochlorite generator and designed to feed a constant flow rate of saturated brine at a maximum pressure of 150 psi

- c) The brine feed pump shall be a diaphragm metering pump. Centrifugal pumps, bellows pumps, or eductors shall not be acceptable.
- d) Brine pump performance shall be reproducible within +/- 2% of maximum capacity.
- e) The brine pump shall have a maximum suction lift of 10 ft once primed.
- f) The brine pump shall perform at a maximum room temperature of 125 F.
- g) The brine pump shall be powered and controlled by the control panel for the onsite chlorine generator.
- h) The flow rate shall be field calibrated by manually adjusting the pump's stroke length.

2) Materials

- a) Pump head shall be PVC.
- b) Pump check valves shall include the following materials: PVC seats and Teflon balls.
- c) Pump diaphragm shall be Teflon-faced, Fabric-reinforced, Elastomer-backed, metal insert.

3) Features

- a) The brine feed pump shall have 1/2" NPT suction and 1/2" NPT discharge connections.
- b) The brine pump shall meet the following standards:
 - (1) NEMA 4X
 - (2) UL Listed
 - (3) CSA Approved

g. Power Transformer/Rectifier

1) Functional Requirements

- a) A switching-mode type transformer/rectifier shall be furnished to provide Direct Current power to each Hypochlorite Generator.
- b) Input to transformer/rectifier shall be 460V +/-5%, 3 Ph, 60 Hz.
- c) Output from transformer/rectifier shall be 730A @ 14VDC
- d) The transformer rectifier shall have a minimum efficiency of 85% at rated output and normal operating conditions.
- e) The transformer rectifier shall be designed for a 100% duty cycle (24 hrs/day & 7 days per week).
- f) The transformer/rectifier shall be appropriate for use at altitudes of less than 3,300 feet above sea level.
- g) The transformer/rectifier shall be air cooled. Maximum room temperature shall be 104 F (40 C). Cooling air shall be free from corrosion fumes.

2) Materials

- a) Enclosure shall be stainless steel, NEMA 1 (IP 20)
- b) Busbar connections shall be silver plated copper.
- c) Busbar connections shall be protected. Bare connections shall not be permitted.

3) Features

- a) The transformer rectifier shall be located on the skid

- b) The transformer rectifier shall include the following protection features:
 - (1) D.C. current and voltage limit.
 - (2) Fan failure detection.
 - (3) The power supply will automatically shut down in the event of a fault.
- c) Output voltage and current shall be monitored by in-built digital voltmeter and ammeter. These instruments shall have accuracy of 1% or better.
- d) A voltage imbalance indicator shall be provided to provide early, quantitative indication of cell scaling.
- e) The following outputs shall be provided:
 - (1) Rectifier Fault
 - (2) Rectifier Running
 - (3) Rectifier Voltage 4-20mA
 - (4) Rectifier Current 4-20mA

h. Electrolyzer

- 1) Functional Requirements
 - a) A sodium hypochlorite solution with a concentration of 0.8% (+/- 0.05%) expressed as available chlorine shall be produced through the electrolysis of brine, consuming only water, salt and power in a hypochlorite generator.
 - b) The electrolyzer shall produce the equivalent of 65 pounds of chlorine per day, and consume a maximum of 3.0 lb of salt and 2.0 kWh AC per lb of equivalent chlorine.
 - c) The electrolyzer shall receive the following process streams: (a) saturated brine from the brine feed pump and (b) dilution water from the softener. Temperature of the process stream shall be between 55 F to 80 F (10 to 26C) while operating.
 - d) Electrical connections between the transformer/rectifier and electrolyzer shall be through copper cables for maximum current flow and maximum heat dissipation. The copper wire connections shall be fully insulated and protected with machined PVC end caps. Bare connections not be permitted.
 - e) The electrolyzer shall only produce hydrogen gas as a by-product of the reaction. Hydrogen gas shall be removed from the electrolyzer, diluted and vented to the atmosphere at the hypochlorite storage tank.
 - f) The electrolyzer shall operate at constant capacity, and automatically start and stop based on the appropriate run permissive conditions satisfied in the local control panel.
- 2) Materials
 - a) The electrolyzer casing shall be 8" diameter clear acrylic pipe to allow for visual inspection of electrodes, with removable PVC end caps to allow access to electrode plates.
 - b) The electrolyzer shall be hydraulically tested at 60 psi for a minimum of thirty (30) minutes per manufacturer's standard testing protocol prior to final assembly and shipment to jobsite.
 - c) The electrolyzer shall be mounted horizontally on the hypochlorite generator skid. To reduce the effects of hydrogen masking and density

- gradients, vertical arrangement of the electrolyzer casing shall not be permitted.
 - d) Inside each electrolyzer cell, anode and cathode plates shall be mounted on a PVC/Titanium chassis. Anode and cathode plates shall be vertically oriented to allow hydrogen gas removal.
 - e) Anodes shall be DSA type, with precious metal oxide coating on a titanium substrate.
- 3) Features
- a) The electrolyzer shall include an integral electrolyte low level switch, to prevent operation of the system if the cell level is low.
 - b) The electrolyzer shall include an inner water delivery tube to allow for concentration and temperature control inside the electrolyzer. About 50% of the water consumed by the electrolyzer is fed through the water delivery tube.

i. Onsite Chlorine Generator Control Panel

- 1) Functional Requirements
- a) One (1) PLC-based control panel shall be furnished for each generator to control and monitor the operation of the SYSTEM.
 - b) Each control panel shall include:
 - (1) One (1) SIEMENS S7-300 PLC with Ethernet & RS-485 Communication Ports and shall be ProfiBus enabled.
 - (2) The HMI (operator interface) shall be SIEMENS TP177B Touch Screen, display area 5.7", Active Color Matrix TFT.
 - c) The control panel shall receive the following discrete inputs:
 - (1) Brine Flowmeter
 - (2) Water Flowmeter
 - (3) Low Cell Level
 - (4) Hydrogen Leak
 - (5) Low Air Flow
 - (6) Rectifier Running
 - (7) Rectifier Fault
 - (8) Containment Area Leak Detection
 - (9) Acid Cleaning System Connected
 - (10) External Interlock
 - d) The control panel shall receive the following analog inputs:
 - (1) Diluted Brine (Generator Inlet) Temperature
 - (2) Hypochlorite (Generator Outlet) Temperature
 - (3) Hypochlorite Tank Level
 - (4) Rectifier Voltage
 - (5) Rectifier Current
 - e) The control panel shall include Intrinsic Barriers for the following inputs:
 - (1) Diluted Brine (Generator Inlet) Temperature
 - (2) Hypochlorite (Generator Outlet) Temperature
 - (3) Low Cell Level
 - f) The control panel shall provide the following discrete outputs:
 - (1) Brine Pump Start/Stop
 - (2) Rectifier Start/Stop
 - (3) Water Solenoid Valve Open/Close

- (4) Safety Solenoid Valve Open/Close
 - (5) Hydrogen Blower Start/Stop
- g) The following alarms as a minimum shall be displayed locally at the HMI:
 - (1) Low Brine Flow
 - (2) Low Brine Temperature
 - (3) Low Water Flow
 - (4) Rectifier Improper Voltage
 - (5) Rectifier Fault
 - (6) Low Cell Level
 - (7) High Outlet Temperature
 - (8) Hypochlorite Tank Overflow
 - (9) Hypochlorite Tank Low Level
 - (10) Low Air Flow
 - (11) Hydrogen Leak
 - (12) External Interlock Open
 - (13) Loss of Analog Signal
- h) The following operating parameters shall be locally displayed at the control panel's HMI:
 - (1) Brine Pump Status
 - (2) Water Solenoid Valve Status
 - (3) Rectifier Status
 - (4) Diluted Brine (Generator Inlet) Temperature
 - (5) Hypochlorite (Generator Outlet) Temperature
 - (6) Main Blower Status
 - (7) Standby Blower Status
 - (8) Hypochlorite Tank Level
- i) The control panel shall provide the following volt-free contacts for remote monitoring:
 - (1) Brine Pump Running
 - (2) Water Solenoid Valve Open
 - (3) Rectifier Running
 - (4) Main Blower Running
 - (5) Generator Running
 - (6) Minor Alarm
 - (7) Priority Alarm
 - (8) Hydrogen Leak Alarm

2) **Materials**

- a) The control panel enclosure shall be powder-coated steel or polycarbonate NEMA 4X with lockable disconnect.

3) **Features**

- a) Input power shall be 460 VAC, 3 phase, 60 Hz.
- b) Control voltage shall be 120 VAC / 24VDC

j. **Saturator**

- 1) Saturator shall be a 500 gallon high-density polyethylene tank with an open top and 50% hinged lid.

- 2) Seismic Restraint System. The tank manufacturer shall provide a seismic restraint system for the tank. The restraint system shall be designed per IBC 2009 and ASCE wind-load and seismic conditions. Design calculations must include both tank and restraint systems loads. Finite analysis of tank must be provided during the submittal process. Anchor bolts and concrete requirements must also be provided. Restraint system shall consist of polyethylene anchor points evenly spaced around the tank base. The restraint points shall be cabled to the tanks lifting lugs with either stainless steel components. All mounting hardware and base plates shall be stainless steel. Restraint system calculations shall be stamped by a professional engineer registered in the State of Oregon and shall include anchor bolt calculations with recommendations on the size number and location of all anchor bolts. All anchor bolts shall be stainless steel.
- 3) The saturator shall include an automatic level control system to maintain a constant liquid brine level.
- 4) Saturator shall be designed for storage of brine solution at ambient temperature and atmospheric pressure.
- 5) The Saturator shall be furnished with the following accessories.
 - a) Hinged lid
 - b) ½ inch FNPT inlet connection.
 - c) ½ inch outlet connection
 - d) Internal brine withdrawal manifold
 - e) Brine level control valve

k. Spare Parts and Special Tools

- 1) The Contractor shall furnish spare parts required to ensure adequate operation of the SYSTEM. Spare parts shall include as a minimum:
 - a) One (1) complete set of spare fuses
 - b) One (1) spare dilution water solenoid valve
 - c) One (1) set of brine metering pump recommended spare parts.
 - d) One (1) electrolytic cell level switch
 - e) One (1) electrolytic cell temperature sensor
 - f) One (1) air flow switch assembly
- 2) The Contractor shall furnish all special tools required for the proper installation, operation and maintenance of any component of the onsite chloring generation system.
- 3) Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the completion of the contract.
- 4) The local equipment supplier shall maintain a stock of regularly required maintenance parts locally to include: Maintenance kits, Valves, Cell level switch, temperature sensor, air flow switch assembly, hydrogen dilution blower and cell o-rings.

l. Hypochlorite Storage Tank.

- 1) A hypochlorite storage/hydrogen dilution tank, totally enclosed, with bulkhead drain, overflow, inlet and outlet connections, with air dilution inlet and outlet connections and blower suitably sized to dilute hydrogen to at least 25% below LEL.
- 2) The hypochlorite storage tank shall have a volume of 1090 gallons and a diameter of 61 inches and maximum height of 102 inches.
- 3) Seismic Restraint System. The tank manufacturer shall provide a seismic restraint system for the tank. The restraint system shall be designed per IBC 2009 and ASCE wind-load and seismic conditions. Design calculations must include both tank and restraint systems loads. Finite analysis of tank must be provided during the submittal process. Anchor bolts and concrete requirements must also be provided. Restraint system shall consist of polyethylene anchor points evenly spaced around the tank base. The restraint points shall be cabled to the tanks lifting lugs with either stainless steel components. All mounting hardware and base plates shall be stainless steel. Restraint system calculations shall be stamped by a professional engineer registered in the State of Oregon and shall include anchor bolt calculations with recommendations on the size number and location of all anchor bolts. All anchor bolts shall be stainless steel.
- 4) The following controls shall be included:
 - a) Pressure transducer level transmitter control with 4-20 mA output for start-stop operation of the system; FM and CSA Intrinsically Safe; Wetted material shall be suitable for 1.0% hypochlorite solution.
 - b) User-adjustable alarms:
 - (1) Overflow
 - (2) High storage level
 - (3) System stop
 - (4) System Start
 - (5) Low storage level and metering pump disable
- 5) The Hypochlorite Storage Tank shall be furnished with the following accessories.
 - a) 2 inch blower inlet connection schedule 80 PVC
 - b) 2 inch vent outlet connection schedule 80 PVC
 - c) 1 inch solution inlet connection schedule 80 PVC.
 - d) 1 inch solution outlet & drain connection
 - e) ½ inch level transducer connection schedule 80 PVC
 - f) Air flow switch
 - g) Tank Level Sensor

m. Chlorine Metering Pump Skid

- 1) The Contractor shall furnish and install a floor-mounted chemical feed pump skid for the chlorine solution. The pump skid shall be specifically designed for feeding the specified chemical solution. A single chemical metering pump

supplier shall be responsible for supplying all components of the metering pump feed system.

- 2) All piping mounted on the panel shall be Schedule 80 PVC. All seals for piping and valves shall be FKM. No metallic connectors shall be used for equipment or pipe mounting on the panel. All transitions from PVC pipe to solution tubing shall be made by threaded tubing connectors that can be screwed or unscrewed by hand. PVC unions shall be placed as shown on the drawings to facilitate equipment removal.
- 3) All metering pumps shall be shop-tested for capacity and pressure prior to shipment with documented results available.
- 4) Chemical Metering Pumps
 - a) General: Provide positive displacement diaphragm metering pumps complete with all accessories as specified herein for variable speed pumping of specified chemicals. Pumps shall be self-priming, valve less/glandless with no dynamic seals in contact with the pumped fluid. Pumps shall be capable of running dry without damage to pump or hose. Pumps shall be able to pull 95 percent of full vacuum.
 - b) The system shall consist of three motor driven diaphragm metering pumps as follows. The metering pump skid shall be plumbed to allow the swing pump (pump 2) to function as a redundant pump for both Pump 1 and Pump 3.
 - (1) Pump 1 shall be used for winter discharge and dedicated to feeding chlorine into the manhole upstream of the chlorine contact chamber as shown on the drawings. This pump shall have a maximum pumping rate of 70 gallons per hour and a minimum pumping rate of 2.9 gallons per hour against a maximum back pressure of 25 psi.
 - (2) Pump 2 is a swing pump that can be used for either the winter discharge or the summer discharge and shall be the same as Pump 1.
 - (3) Pump 3 shall be used for summer irrigation and dedicated to feeding chlorine into the pipe on the downstream side of the existing irrigation water filter as shown on the drawings. This pump shall have a maximum pumping rate of 39 gallons per hour and a minimum pumping rate of 1.9 gallons per hour against a maximum back pressure of 100 psi.
 - c) All pumps shall have the following features.
 - (1) 4-20 mA input for flow pacing
 - (2) 4-20 mA output for dosing feedback
 - (3) Dosing monitor with pump failure alarm contact
 - (4) 115AC/60hZ Operating Voltage
 - (5) NSF 61 Certification

(6) 2 Year Warranty

5) Metering Pump Skid Accessories

- a) Metering pumps shall be mounted on a black, grey, or blue, UV-protected polypropylene support stand suitable for floor or wall mounting. A single chemical metering pump supplier shall be responsible for supplying and assembling all components of the panel, in addition to testing the panel-mounted metering system prior to shipment. The stand shall include the following accessories, pre-piped as shown on the drawings.
- b) Two adjustable-pressure, diaphragm-type back pressure/anti-siphon valve, constructed of materials compatible with chemical to be used. The back pressure valve shall be of in line construction with a manual bypass valve to allow manual routing of the chemical to waste. The back pressure valve shall be as manufactured by Griffco or approved equal.
- c) Three in-line, adjustable-pressure, diaphragm-type pressure relief valve, constructed of materials compatible with chemical to be used. The pressure relief valve shall be as manufactured by Griffco or approved equal.
- d) A 2000 mL calibration chamber shall be of PVC & acrylic construction. The units shall be as manufactured by Koflo, Griffco or equal.
- e) Three discharge pressure gauges and compatible PTFE isolator diaphragms shall be provided to aid in setting backpressure and pressure relief valves and to continuously indicate system backpressure.
- f) True-union ball valves shall be utilized with isolation valves provided at all equipment connections. Seals shall be compatible with the chemical being pumped. Vented ball valves shall be provided for sodium hypochlorite service to prevent pressure build-up within the system during an out-gassing condition.
- g) Three pulsation dampeners shall be provided with one plumbed for each pump. Pulsation dampeners shall be PVC/PTFE 10 cubic inch.
- h) A PVC wye strainer with FKM seals shall be located on the solution inlet

n. Chlorine Injection Quill

- 1) A retractable injection quill shall be provided for the chlorine injection into the irrigation supply line as shown on the drawings.
 - (1) The quill shall be comprised of a PVC solution tube and stainless steel ball valve. The quill shall be for connection to the existing female threaded coupling on the exposed irrigation pipe near the existing filter. The coupling is believed to be 1 inch female thread. Contractor shall provide all adapters and bushing needed

to reduce from 1 inch to the 3/4" solution piping/tubing from the chlorine pump skid. Contractor to verify the size of the threaded coupling prior to ordering injection quill. The quill shall protrude 3 inches into the ductile iron irrigation pipe and shall be furnished with an integral check valve.

- (2) The Ball Valve/Quill diffusers shall be model EB as manufactured by SAF-T-FLO with integral check valve or approved equal.
- (3) The Quill shall be furnished with a redundant PVC true union check valve as shown on the drawings. The check valve shall have threaded end connections and have Viton o rings and seats. The check valve shall be Hayward TC series or approved equal.

o. Hydrogen Gas Leak Detector

- 1) A gas leak detector shall be supplied for monitoring the concentration of hydrogen gas in the chlorine area.
- 2) The system shall consist of a NEMA 4X alarm module and a remote mounted gas sensor/transmitter.
- 3) The alarm module shall consist of a NEMA 4X enclosure containing one modular receiver, one power supply, and an audible horn. The enclosure shall contain a hinged window to allow access to controls without tools, and shall be suitable for wall or surface mounting.
- 4) The receiver module shall provide a high intensity digital LED display of gas concentration, plus alarm indicator LED's for Warning, Alarm, and Trouble. Two programmable alarm set points shall be provided for warning personnel of differing levels of leakage. Gas leak alarm shall be indicated by flashing LED indicators on the alarm receiver and activation of the audible horn. The concentration of the gas shall be displayed directly in PPM units. Three alarm relays shall be provided for external alarming functions. Each alarm relay shall be independently assignable to either the low or the high alarm set point, and shall also be programmable for latching and/or fail-safe operation. In addition, a separate Trouble alarm shall be provided on each receiver to indicate the loss of signal from the sensor/transmitter, or to alarm the loss of sensitivity of the gas sensor if Auto-Test is supplied on the sensor. Each receiver shall provide an isolated 4-20 mA output signal proportional to gas concentration, and shall also contain remote reset input terminals to allow alarm acknowledgment from a remote location.
- 5) A sensor/transmitter shall provide the gas measurement function for the system. The sensor/transmitters shall consist of a stable electrochemical gas sensor that shall generate a signal linearly proportional to gas concentration. The sensor shall be close coupled to electronic amplifiers to boost the signal level, and the entire assemblies shall be coated to minimize potential RFI interference. Sensor/transmitter shall transmit gas concentration data digitally to avoid

electrical interference, and shall be capable of communicating over a minimum of 1000 feet of two conductor cable.

- 6) The power supply in the receiver modules shall be a modular design providing DC power to up to two receiver modules. The power supply shall be capable of operation from any voltage from 85-250 volts, AC or DC, without adjustment, and shall also contain a power failure relay for remote power failure indication.
- 7) The gas detection system shall be Wallace & Tiernan Acutec 35, or approved equivalent.

p. Titration Kit.

- 1) A titration kit to measure the product concentration and brine concentration shall be furnished with the OSEC system.

2.3 SULFUR DIOXIDE GAS FEED SYSTEM

a. Sulfonator

- 1) The new sulfonator shall be as specified below, of the all vacuum operated type, consisting of automatic vacuum regulator valves at the gas supply, wall mounted control units and 3/4" inch fixed throat injectors pre-mounted on 1/2" PVC panels with necessary accessories.
 - a) The chlorinator shall be Wallace & Tiernan V10K Chlorinator, panel mounted, or approved equal.
 - b) (1) 10 inch Rotameter with 50 PPD capacity.
 - c) Automatic V-notch Feedrate Positioner for flow paced control
 - d) SFC-SC Controller flow proportional controller
 - e) 120VAC power
- 2) Vacuum Regulator Valves
 - a) Two new regulator valves shall be supplied for the chlorine ton cylinders and have a maximum capacity of 200 lbs/day. The vacuum regulator valves shall be Wallace & Tiernan 210S, or approved equal.
 - b) One new gas pressure relief valve/manifold and vent shall be supplied with the regulator valves. Vent piping shall be 1/2-inch O.D. polyethylene tubing per ASTM D-1693, installed on a downward slope towards the termination point on the exterior of the building. The building penetration shall be made as shown in the drawings. The vent line shall terminate with an insect screen.
 - c) The sulfur dioxide gas supply system shall have the capability to automatically switch over from a depleted gas supply cylinder to a new cylinder.
- 3) Sulfonator Control Unit

- a) The sulfonator control unit shall be wall mounted on a ½-inch polypropylene panel, size as shown on the drawings.
- b) The sulfonator control unit shall have the following maximum gas feed capacities:
 - (1) Sulfonator: 50 lbs. Per day
- c) The control unit shall be supplied for the following control modes:
 - (1) Sulfonator: manual and flow proportional by 4-20 ma signal.
- 4) Sulfonator Piping
 - a) All water supply and chemical solution piping shall be schedule 80 PVC, conforming to ASTM d-1784 and ASTM d1785, sizing as shown on the plans. All gas supply vacuum piping shall be ½-inch schedule 80 PVC. A maximum of 3 feet of 1/2-inch O.D. polyethylene tubing shall be installed between the vacuum regulator valves, the control units, the injectors and their respective PVC pipe connection points.

b. Sulfur Dioxide Injector

- 1) The injector shall be wall-mounted on a ½-inch panel, size as shown on the drawings.
- 2) Injector operating water supply control for the sulfonator shall be automatic by means of controls incorporated into the main control panel.
- 3) The injector shall be a ¾" -inch fixed throat injector, pre-mounted on the panel. Each injector shall include a venturi combination capable of producing sufficient vacuum to feed the specified volume of gas per day utilizing the specified water supply systems. Back pressure to the injectors may be monitored by the pressure gauge mounted downstream of the injector on the panel and may be regulated using the diaphragm valve on the panel.
- 4) The injectors shall be a Wallace & Tiernan ¾" fixed throat injector, or equal. Submit operating water hydraulic requirements for approval.

c. Sulfur Dioxide Gas Injector Panel

- 1) All piping on the panel shall be schedule 80 PVC. No metallic connectors shall be used for equipment or pipe mounting on the panel.
- 2) The following accessories shall be pre-mounted on the injector panels:
 - a) ¾" anti-siphon injector as specified above.
 - b) True union style ball valves and check valves as shown on the plans. George Fischer Type 546, Chemtrol, Spears or approved equivalent.

- c) Variable area flow meter, 0-20 gpm capacity. A direct view flow meter shall be provided on the panels. Scale shall be in gal/min. Maximum scale shall be such that the flow rate of the injector shall be between 40% and 80% of maximum scale. The unit shall be a Blue-White F-451, or approved equal.
 - d) Diaphragm valves shall be Type 514 PVC with true union socket connections on both sides as manufactured by George Fischer.
 - e) A PVC SC 80 wye strainer shall be provided on the panel. The waste connection shall be provided with a valve and ½ -inch pipe connections. Strainer size shall be 20 mesh. Strainer to be Spears, Hayward or approved equivalent.
 - f) A gauge 0-100 PSI with shut-off valve. Gauge to be minimum 2-inch dial with 1/4-inch connection, Ashcroft, Marsh or approved equivalent. Gauge cock to be crane no. 744 or approved equivalent.
- 3) Panels shall be as manufactured by TMG Services, Tacoma, WA or approved equivalent.

d. Flow Sensor System

- 1) A new flow sensors shall be furnished and installed as shown in the drawings.
- 2) Flow sensor shall be furnished with a single readout and PVC Tee pipe fittings as a complete system.
- 3) Operation scheme: The flow sensor system shall be configured to operate as described below. The flow sensor shall indicate flow rate from the carrier water supply pump. The signals from the sensor shall be used to provide a signal for an alarm condition as follows.
 - a) If the sulfur dioxide feed carrier water pump is on and the flow rate is less than one half (0.5) gpm, then a “Sulfur dioxide carrier water pump fail” alarm will be signaled.
- 4) The sensor readout shall be supplied with the manufacturer’s wall-mount bracket and splash proof cover.
- 5) The flow sensor system shall be installed in strict accordance with the manufacturer’s instructions.
- 6) Flow sensors shall be model Signet 515 Rotor-X Standard (with red cap) model P51530-HO as manufactured by George Fischer, or approved equal.
- 7) The sensor readout shall be model Signet 8900 Multi-Channel, Multi-Parameter Controller model 3-8900-L-4-AC-2S-2A as manufactured by George Fischer, or approved equal.

e. 150-Lb Cylinder Scales

- 1) Two new mechanical scales shall be provided for the 150 lb sulfur dioxide gas cylinders. The scales shall each provide a readout in net pounds of gas remaining in the cylinder. A single readout (indicator) shall be provided for each cylinders.
- 2) The scale units shall be a Force Flow electronic Chlor-Scale 150, or approved equivalent.
- 3) The scale shall be provided with a dual channel digital readout capable of displaying net lbs of gas in each cylinders. The readout unit shall be Force Flow Solo G2, or approved equal.

f. Emergency Valve Closure System

- 1) An emergency valve closure system shall be provided with the following specification and components.
 - a) (2) Powell E-Pro Electronic actuators, or approved equal, with actuator mounting brackets, and storage brackets.
 - b) Dual actuator control panel, 120 VAC power, FRP enclosure with a remote mounted emergency stop buttons.
 - c) Universal power supply, Liebert GXT4-3000RT120, or approved equal.
 - d) (2) Sulfur Dioxide cylinder wrenches.

g. Gas Leak Detector

- 1) A gas leak detector shall be supplied for monitoring the concentration of Sulfur Dioxide Gas in the sulfur dioxide storage room.
- 2) The system shall consist of a NEMA 4X alarm module and a remote mounted gas sensor/transmitter.
- 3) The alarm module shall consist of a NEMA 4X enclosure containing one modular receiver, one power supply, and an audible horn. The enclosure shall contain a hinged window to allow access to controls without tools, and shall be suitable for wall or surface mounting.
- 4) The receiver module shall provide a high intensity digital LED display of gas concentration, plus alarm indicator LED's for Warning, Alarm, and Trouble. Two programmable alarm set points shall be provided for warning personnel of differing levels of leakage. Gas leak alarm shall be indicated by flashing LED indicators on the alarm receiver and activation of the audible horn. The concentration of the gas shall be displayed directly in PPM units. Three alarm relays shall be provided for external alarming functions. Each alarm relay shall be independently assignable to either the low or the high alarm set point, and shall also be programmable for latching and/or fail-safe operation. In addition, a separate Trouble alarm shall be provided on each receiver to indicate the loss of

signal from the sensor/transmitter, or to alarm the loss of sensitivity of the gas sensor if Auto-Test is supplied on the sensor. Each receiver shall provide an isolated 4-20 mA output signal proportional to gas concentration, and shall also contain remote reset input terminals to allow alarm acknowledgment from a remote location.

- 5) A sensor/transmitter shall provide the gas measurement function for the system. The sensor/transmitters shall consist of a stable electrochemical gas sensor that shall generate a signal linearly proportional to gas concentration. The sensor shall be close coupled to electronic amplifiers to boost the signal level, and the entire assemblies shall be coated to minimize potential RFI interference. Sensor/transmitter shall transmit gas concentration data digitally to avoid electrical interference, and shall be capable of communicating over a minimum of 1000 feet of two conductor cable.
- 6) The power supply in the receiver modules shall be a modular design providing DC power to up to two receiver modules. The power supply shall be capable of operation from any voltage from 85-250 volts, AC or DC, without adjustment, and shall also contain a power failure relay for remote power failure indication.
- 7) The gas detection system shall be Wallace & Tiernan Acutec 35, or approved equivalent.

h. Spare Parts

- 1) The contractor shall provide a standard set of tools, and spare gaskets for all equipment.
- 2) The contractor shall provide a preventative maintenance kit for the sulfonator injectors and vacuum regulators.

i. Gas Cylinder Storage Brackets

- 1) The number, location, size, and configuration of the cylinder brackets shall be as shown on the plans.
- 2) Bracket shall be fabricated from A-36 steel as shown on plans.
- 3) Contractor shall submit shop drawings for approval prior to fabrication.
- 4) Bracket shall be hot dip galvanized after fabrication prior to installation.
- 5) Bracket shall be sized for use with 150 lb. sulfur dioxide cylinders as shown on the plans.

2.4 NON-POTABLE CARRIER WATER SUPPLY SYSTEM

- a. This subsection describes a complete screening and pumping system package for the supply of non-potable chemical solution mixing water (i.e., carrier water). The package includes the following components:
- 1) Pump screening vault (1)
 - 2) Two submersible pumps. One pump will be installed. The second will be an uninstalled spare. The uninstalled spare shall be furnished with a power cable and metric plug end.
 - 3) Pump discharge assemblies
 - 4) Pump float switch assemblies
 - 5) Piping, valves, unions, bushings, couplings, etc.
- b. Pump Screening Vaults:
- 1) Orenco Systems, Inc. Model PVU Series, Universal Biotube® Pump Vault or engineer-approved equal, installed as shown on the drawings. The screen shall be equipped with lifting handles to permit screen removal while standing on top of the structure in which the pump vault is located. The screen lifting handles shall be extended to within 6-inches of the bottom of the structure. The Biotube Pump Vault shall consist of a 12-inch diameter HDPE vault with eight (8) 2-inch diameter holes evenly spaced around the perimeter. Housed inside the HDPE vault shall be the biotube assembly consisting of 1/16-inch filter mesh. One vault is required as follows.
 - a) Vault height 95 inches, cartridge height 36 inches, inlet hole height 18 inches.
- c. Pump Discharge Hose and Valve Assemblies:
- 1) The pump shall be fitted with a pump discharge assembly that includes a check valve, and isolation ball valve, and a flexible hose section.
 - 2) Rigid pipe shall be as shown in the drawings.
 - 3) Ball valves and ball check valves shall be 1.5-inch diameter true union valves as manufactured by Spears, Hayward, Chemtrol or approved equivalent.
 - 4) Flexible hose, fittings, and clamps shall be as shown in the drawings.
- d. Pumps:
- 1) The screened pump vault shall house the carrier water pump with controls as shown on the electrical plans and specifications. A total of two (2) pumps are required. One pump shall be installed and the other is an uninstalled spare. The uninstalled spare shall be furnished with a power cable and metric plug and shall be interchangeable with the installed pump.
 - 2) Pumps must be approved for use in the pump vault as specified above and rated for continuous duty 24 hours per day 7 days per week operation.

- 3) Carrier water pumps shall be as follows, or approved equal.
 - a) Orenco Systems Inc. Submersible Effluent Pumps, three phase, motors with extra heavy duty (SO) electrical cord with ground.
 - b) Sulfur Dioxide
 - (1) Model PF 100534, 0.50 hp, 480 V, 3-phase.
 - (2) Each pump shall be capable of operating at a flow rate of 10 GPM against a head of 140 feet.
- 4) The pumps shall be provided with a heavy duty power cord long enough to connect to the disconnect with 10 feet of slack at the disconnect end (*neatly coiled and fastened with ties, to allow the pump to be lifted from the vault without the need to disconnect wiring*). The pump cable length shall be sufficient to mount the pumps as shown on the construction drawings with no splices in the pump cable.
- 5) Pump shall be UL and CSA listed as an effluent pump. Pump shall be provided with a non-prorated five-year warranty.
- e. Non Potable Carrier Water Piping and Valves.
 - 1) All non-potable water/carrier water piping shall be as shown on the plans and detailed in Section 15060 Pipe Systems.
 - 2) All ball valves shall be true union style ball valves as shown on the plans as manufactured by Chemtrol, Spears or approved equivalent.
 - 3) All above-grade, exterior, exposed PVC piping shall be painted in accordance with Section 09900 to protect against UV degradation and insulated to protect against freezing.

2.5 DRAIN PUMP

- a. A drain pump shall be provided in the chlorine contact chamber as shown on the plans. The drain pump shall be a submersible sump pump capable of handling solids up to ¾ inch diameter. The pump housing shall be cast iron with an epoxy coating for corrosion resistance. All pump hardware shall be stainless steel. Pump motor shall be rated for 115 volt 0.4 horsepower. The pump shall be capable of pumping 20 gallons per minute against a head of 27 feet. The drain pump shall be provided with a sufficient length of power chord to connect to the power supply connection shown on the drawings with at least 10 feet of additional slack. Drain pump shall be Orenco model PFEF4011-B, or approved equal.
- b. Drain Pump Discharge piping and valves shall be as noted on the plans and specified in Division 15. All above-grade, exterior, exposed PVC piping shall be painted in accordance with Section 09900 to protect against UV degradation.

2.6 SPILL CONTAINMENT PALLETS

- a. Contractor shall furnish spill containment pallets for the DAF coagulant tote storage area and for the polymer drum storage area as shown on the drawings.
- b. Coagulant Tote Containment Pallets.
 - 1) Two (2) coagulant tote containment pallets shall be provided. The containment pallets shall be specifically designed for IBC totes and have a minimum storage capacity of 350 gallons and load capacity of 8500 pounds. Maximum dimensions shall be 65 inches by 65 inches. Pallet material shall be Polyethylene. Tote containment pallets shall be Ultratech International Model 1157 or approved equal.
- c. Polymer Drum Containment Pallets.
 - 1) One (1) polymer drum containment pallet shall be provided. The containment pallet shall be specifically designed for four (4) 55 gallon drums and have a minimum storage capacity of 60 gallons and load capacity of 6000 pounds. Maximum dimensions shall be 60 inches by 60 inches. Pallet material shall be Polyethylene. Drum containment pallets shall be Uline Model H-4034 or approved equal.

PART 3: EXECUTION

3.1 SHIPPING AND EQUIPMENT DELIVERY

- a. All equipment and materials shall be inspected against approved Shop Drawings at time of delivery. Equipment and materials damaged or not meeting requirements of the approved Shop Drawings shall be immediately returned to the supplier for replacement or repair.
- b. The Contractor shall handle and store the equipment and materials in a dry location and protect them from the elements according to the manufacturer's instructions.

3.2 INSTALLATION

- a. All equipment to be located as shown, and rigidly attached to walls or floor as shown or directed by Owner's Representative. Install all equipment in strict accordance with manufacturer's recommendations. All work to be set plumb or level, as applicable, to be rigid and neat in appearance.

3.3 PIPING

- a. All piping shall be installed as shown on the plans or as directed by Owner's Representative.
- b. Minimum cover for all buried piping shall be 30 inches.
- c. All piping shall be watertight and hydrostatically tested to 150 PSI or 50% over the maximum operating pressure and installed in a professional manner.

- d. Water piping shall be installed on sufficient grades to prevent air pockets.
- e. All exposed PVC piping shall be painted to protect against UV degradation as specified in Section 09900.

3.4 INSPECTION, STARTUP AND TRAINING

- a. The Contractor shall furnish a representative of the manufacturer to perform inspection, startup and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment.
- b. The representative shall check the installation and supervise initial startup of the equipment. He or she shall provide written certify that the installation is correct and that the equipment has operated satisfactorily.
- c. After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the Owner's personnel for one 8 hour day in the proper operation and maintenance of the equipment.
- d. In addition to the initial training, the manufacturer shall provide one 8 hour day of training at the time requested by the Owner within the one year maintenance and guarantee period. This service would be in addition to any warranty work.

3.5 ONSITE CHLORINE GENERATION SYSTEM PERFORMANCE TEST

- a. The representative of the manufacturer shall complete a performance test as set forth in this specification, a performance test shall be carried out for a period of eight (8) consecutive hours.
- b. Necessary pre-requisites for the performance test are:
 - 1) System has been started up to the satisfaction of Owner and Manufacturer.
 - 2) System must be running before the test period starts.
 - 3) Incoming water temperature is higher than 55 F, but lower than 80 F.
 - 4) Incoming water hardness is less than 17 mg/L
 - 5) Solar salt with a minimum sodium chloride (NaCl) content of 99.5% is available. City to provide salt.
 - 6) Brine pump has been calibrated.
 - 7) Ultrasonic Level sensor in hypochlorite tank has been calibrated
 - 8) Power meter (by others) measuring AC feed to rectifier has been calibrated.
- c. Four performance parameters shall be measured:
 - 1) Hypochlorite Solution Concentration
 - a) Sodium hypochlorite solution samples shall be taken at the outlet of the hypochlorite generator.
 - b) Samples shall be taken every hour during the 8-hour testing period.
 - c) Samples shall be analyzed for available chlorine concentration following titration procedures as per the ANSI/AWWA Standard B300-99 Section 5.2.2 "Testing for Available Chlorine in Sodium Hypochlorite".
 - d) The test shall be deemed successful if the average chlorine concentration is between 0.75 and 0.85% (7.5 to 8.5 g/L).

- 2) Generation Capacity
 - a) The generation capacity of the system shall be determined by multiplying the volume of solution generated by the system during the 8-hr testing period by the average of the eight hypochlorite concentrations measured (reported in g/L or lb/gal).
 - b) The volume of solution generated during the testing period shall be measured by comparing the liquid level in the hypochlorite storage tank before and after the 8-hr test as measured by the Ultrasonic sensor.
 - c) The generator capacity shall be reported in pounds per day.
 - d) The test shall be deemed successful if the generator capacity is greater than 65 lb/day.
 - 3) Salt Consumption
 - a) Brine samples shall be taken at the inlet of the hypochlorite generator every hour during the 8-hour testing period.
 - b) Temperature and specific gravity shall be measured for each sample to determine salt concentration, expressed in mg/L.
 - c) Brine feed rate shall be determined by calibrating the brine feed pump before the testing period starts.
 - d) Salt consumption during the 8-hr testing period shall be determined by multiplying brine flow rate times the average of the salt concentrations, and dividing by the total mass of chlorine produced in the 8-hr testing period.
 - e) The salt consumption shall be reported in pounds of salt per pound of equivalent chlorine.
 - f) The test shall be deemed successful if the salt consumption is less than 3.0 lb of salt per lb of equivalent chlorine.
 - 4) Power Consumption
 - a) A kilo-watt meter (supplied by the Contractor) shall be used to measure incoming AC power to the transformer/rectifier.
 - b) AC power consumption, expressed in kW shall be recorded every hour during the 8-hr testing period.
 - c) The total power consumption shall be determined by multiplying the average kW reading by 8 hours and dividing the product by the total mass, pounds chlorine produced in the 8 hour period.
 - d) The test shall be deemed successful if the power consumption is less than 2.0 kWh per lb of equivalent chlorine.
- d. Should any of the performance tests as described above be deemed unsuccessful, the Contractor shall, at its own cost, make any and all the modifications required to achieve a successful test.
 - e. Once all four performance tests are successful, the manufacturer's representative shall issue a Final Acceptance letter to the Owner.

PART 4: SPECIAL PROVISIONS

None.

SECTION 11260
REFRIGERATED WASTEWATER SAMPLERS AND ENCLOSURES

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing and installing automatic composite samplers and enclosures complete with all appurtenances and accessories specified or required to provide an operational system.
- b. Two samplers are required for this project. One is located near the headworks and one is located adjacent to the compliance manhole near the chlorine contact chamber.

1.2 MANUFACTURER'S REPRESENTATIVE

- a. The sampler manufacturer shall furnish the service of a qualified representative to supervise or verify the installation and start-up of the sampler. A qualified manufacturer's representative shall be one who has had at least two years experience in the installation of the type of sampler specified for this project.
- b. At the completion of the sampler installation, the following certifications shall be submitted as a minimum and included in the front of the O&M manuals.
 - 1) Certification letter signed by the manufacturer's representative stating the following as a minimum:
 - a) The installation is as specified and is acceptable to the manufacturer, and the sample hose and strainer are properly installed.
 - b) The warranty and/or guarantee will be in full effect during the warranty period with no qualifications or reservations.

1.3 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) Submittals for Record
 - a) The Contractor shall submit an installation and operation certificate and a statement from the manufacturer as outlined above.
 - b) Six (6) copies of manufacturer's operations & maintenance instructions for the sampler and software for inclusion in the O&M manuals.
 - 2) Submittals for Review
 - a) Descriptive literature, bulletins or other data describing the system equipment.

- b) Complete list of equipment and appurtenances included, complete, with manufacturer's name and model number.
- c) General arrangement and dimension drawings.
- d) Sectional assembly drawings.
- e) Materials of construction.
- f) Name of warranty service available through factory authorized dealers or service contractors within a 100 mile radius of the installation.

1.4 ELECTRICAL AND CONTROLS COORDINATION

- a. If the current requirement of any motor or piece of equipment is increased to such an extent that the wiring or conduit for that motor or equipment must be increased from that shown on the electrical drawings, the Contractor shall furnish and install the larger items. The increased wiring and conduit cost shall be provided at no additional cost to the Owner.

PART 2: PRODUCTS

2.1 SAMPLER

- a. All field instruments and devices shall be equipped with an identification tag firmly affixed to the instrument or device. Each tag shall show the manufacturer's name, serial number and part number.
- b. The sampler shall consist of a refrigerated sampler for single bottle composite sampling applications. The instrument shall route samples to a single storage container for collection and off-site analysis. The instrument shall be suited to collect priority pollutant or general purpose sampling. All components shall be provided by a single manufacturer.
- c. The refrigerated composite sampler shall be capable of representatively collecting and preserving, by refrigeration, of liquid samples.
- d. The unit shall be capable of operation on 120V AC, single phase power and be provided with a six foot cord and male cord end. The controller shall contain an internal lithium battery to provide the sampler with a continuous memory. This battery shall have a minimum typical life of five (5) years and shall maintain the sampler's program settings when the sampler is turned off and in the event of an external power interruption.
- e. The influent sampler shall be designed for operation in outdoor environments. The effluent sampler shall be design for operation in indoor environments.
- f. The refrigerated sampler cabinet shall be constructed of steel with vinyl laminate over-coating.

- g. The sample compartment door shall have a compressible gasket seal and positive mechanical latch.
- h. The temperature control system shall maintain 4°C in the refrigerated compartment in ambient temperatures to 120°F. The desired temperature shall be entered on the sampler keypad and indicated on the display.
- i. The thermal control system shall be digital microprocessor-based and shall respond to a system of temperature sensors, which shall continually monitor the evaporator plate, ambient air, and sample liquid. Control systems relying on a knob to set “colder or warmer” shall not be considered equivalent.
- j. An evaporator plate heater shall assure frost-free operation.
- k. Refrigerated compartment temperature shall be indicated on the sampler controller display. Refrigerator temperature shall be data-logged for future review and compliance confirmation by accessing through the screen.
- l. Logged data shall also be available through optional software and DTU for reporting and graphing.
- m. For maximized cooling efficiency and to protect the compressor assembly from corrosion caused by heavier than air corrosive gases, the compressor assembly shall be mounted above the sample compartment. A compressor located at floor level shall not be acceptable.
- n. The compressor compartment shall be side ventilated to allow locating the sampler against a wall.
- o. The refrigerated sample compartment shall have rigid foam in place insulation on the walls, bottom, and top.
- p. The thermostat/thermal control system shall be housed within a NEMA 4X, 6 enclosure.
- q. The sampler shall be capable of receiving a 60 mL/sec flow.
- r. Refrigeration temperature shall be maintained at 4°C (39°F) in a 49°C (120°F) ambient, and controlled by a thermal mass equivalent to 150 mL of water in compliance with EPA methods.
- s. The sample volume shall be programmable in milliliters, one mL increments from 10 to 9,999 mL.
- t. Sample modes shall include multiple bottle time, multiple bottle flow, composite time, composite flow, flow with time override, variable interval, start/stop, and level actuation.
- u. Sampler operation shall terminate automatically with a completed sample program and shall be accomplished electronically with no switch or sensor coming in contact with the liquid.

- v. It shall be possible to manually initiate a sample cycle without interrupting the program.
- w. There shall be a provision to delay the sampling program from 1 to 9,999 minutes.
- x. The sampler shall have the built-in and switch selectable capability for both timed cycle and flow proportional sampling.
- y. The sampler shall use constant time/variable volume sampling method where regularly timed samples are adjusted for size depending on flow rate.
- z. The sampler shall be provided with one polyethylene composite container (2.5 gallon minimum) for collecting composite samples.
- aa. Operating instructions shall be integral to the control panel.
- bb. The samplers shall be provided with all necessary accessories required for flow pacing the sampler by a digital pulsed flow signal.
- cc. The samplers shall be the AS950 Sampler manufactured by Hach Company, or approved equivalent. The influent sampler shall be the All-Weather version and the effluent sampler shall be the non All-Weather version.
- dd. All compartments and doors shall be lockable.

2.2 SUCTION LINES & STRAINERS

- a. The samplers shall be provided with a suction line and strainer. The suction line shall be made of 3/8 inch ID vinyl. The suction lines shall be 25 feet long. A weighted stainless steel strainer specifically designed for sampling a shallow depths shall be provided. Strainers shall be Hach Part Number 4652 or equal.

2.3 SAMPLER ENCLOSURES

- a. The effluent sampler shall be housed in an FRP enclosure as specified herein.
- b. The shelter shall have a minimum inside dimension of 2'-9" wide x 2'-3" depth x 4' height, and be of single piece construction including the integrally molded floor. Supplier shall verify that this enclosure size is sufficient to house the specified sampler. A hinged door consisting of a single piece molded top and front panel shall be of the same construction, and shall provide complete access to all internal workings.
- c. The insulated shelter shall be constructed of R-7 insulating foam (minimum) that is totally encapsulated between 1/8-inch minimum fiberglass reinforced polyester skins. There shall be a side mounted 3/4-inch plastic drain hole to accommodate the sampler tubes, or to provide water drainage in the event of any overflow within the shelter.
- d. A gull wing type front lifting door with molded handles shall be hinged at the back with T-304 stainless steel strap hinges, and shall include two counterpoise springs for easy lifting. Two locking latches shall be provided for internal security. Two louvered vents with internal fiberglass screening shall be located at the lower front portion of the door to

provide air circulation. The entire open perimeter of the door shall seat tightly against a closed cell neoprene weather seal.

- e. A support bar shall be provided to hold the door open for easy front and top access while working within the shelter.
- f. The shelter shall comply with NEMA 3R standards. Shelter shall have a 10-15 mil gel coat exterior finish with ultraviolet inhibitors, and exterior color shall be white.
- g. The back of the shelter shall be fitted with a flush mounted male weatherproof grounding plug for use with any external 120 VAC, 60 Hz, power supply.
- h. A 4-plex connection box shall be mounted inside the shelter for easy electrical hookup.
- i. The shelter shall be provided with penetrations as required for all sensor cables, probe cables and sample tubes shown on the drawings or specified herein.
- j. The shelter shall be supplied with an exhaust fan to assure adequate ventilation, and shall include a cooling thermostat to help regulate and maintain internal temperature.
- k. The shelter shall be supplied with interior lighting to illuminate the sampler control module when the door is open.
- l. The shelter shall be supplied with an internal heater to prevent freezing and shall include a heating thermostat to regulate and maintain the internal pressure.
- m. The sampler shall be supplied with all internal wiring and conduit for the power receptacles, lighting, ventilation and heating equipment preassembled at the factory prior to shipping. Electrical conduit, fittings, couplings, and appurtenances shall be solid or flexible pipe made from corrosion resistant materials.
- n. The sampler enclosure shall be a Model 4A Shelter as manufactured by Plasti-Fab, Inc., Tualatin, Oregon, Gemini Equipment Enclosure manufactured by Open Channel Flow, Boise, ID, or approved equivalent.

PART 3: EXECUTION

3.1 INSTALLATION

- a. The Contractor shall install the sampler according to the manufacturer's recommendations and shall supply and install all piping and wiring as necessary to complete the system.
- b. The sampler shall enclosures shall be securely anchored to concrete slabs in accordance with manufacturer's recommendations.

3.2 INSPECTION, START-UP AND TRAINING

- a. The Contractor shall furnish a representative of the manufacturer to perform inspection, startup and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment.
- b. The representative shall check the installation and supervise initial startup of the equipment. He shall certify that the installation is correct and that the equipment has operated satisfactorily.
 - 1) These services shall also include a minimum of one 2-hour (on-site) training session to instruct the Owner's personnel in the operation and maintenance of the equipment. This shall be in addition to the startup and calibration requirements.
- c. If the General Contractor fails to complete the installation of all systems needed for the manufacturer's representative to perform startup and testing services to the satisfaction of the Engineer, the representative shall make additional visits as required to complete the testing and training at no additional cost to the Owner.

PART 4: SPECIAL PROVISIONS

None.

SECTION 11285
ACTUATED EQUALIZATION BASIN CONTROL VALVE

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing the actuated control valve for the equalization basin including the motorized valve operator, valve, mechanical design, motor controls, installation, and testing.
- b. All work performed under this section shall be in accordance with all approved trade practices and manufacturers' recommendations.
- c. A single supplier shall provide the valve and valve actuator. The valve actuator shall be mounted to the valve by the actuator manufacturer (or a shop approved by the manufacturer prior to shipment). Field mounting of the actuator to the valve shall not be allowed.
- d. A representative of the manufacturer shall provide start-up services and training in the operation and maintenance of the equipment.
- e. Operation and maintenance manuals shall be provided for all equipment furnished and/or installed.

1.2 REFERENCES

- a. American Water Works Association (ANSI/AWWA C540-02 Power-Actuating Devices for Valves and Slide Gates)
- b. National Electrical Manufacturer's Association (NEMA)

1.3 MANUFACTURER'S REPRESENTATIVE

- a. The actuator manufacturer shall furnish the service of a qualified representative to supervise the installation, start-up and field testing of the equipment. A qualified manufacturer's representative shall be one who has had at least two years experience in the installation of the types of equipment specified for this project.
- b. At the completion of the installation, the following certifications shall be submitted as a minimum and included in the front of the O&M manuals.
 - 1) Certification letter signed by the manufacturer's representative stating the following as a minimum:
 - a) All required installation manuals were provided to the equipment installer with the equipment.
 - b) The installation is as specified and is acceptable to the manufacturer.

- c) The warranty and/or guarantee will be in full effect during the warranty period with no qualifications or reservations.

1.4 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:

- 1) Submittals for Record

- a) The Contractor shall submit an installation and operation certificate and a statement from the manufacturer as outlined above.
- b) The Contractor shall submit written documentation describing the results of the performance testing described below. The documentation shall be prepared by the actuator manufacturer as described below.
- c) Manufacturer's operations & maintenance instructions and warranty for inclusion in the O&M manuals as described in Section 01300.

- 2) Submittals for Review

- a) Design Data: Submit operating torque calculations for each valve size and class. Show minimum and maximum rated torque output for the operators supplied. Size operators for 2 times the maximum required valve seating/unseating torque.
- b) Shop drawings including complete specifications, descriptive drawings, and literature of the equipment and appurtenances.
- c) Wiring schematics including clearly labeled power and control field termination points.
- d) Descriptive literature, bulletins or other data describing the system equipment.
- e) Complete list of equipment and appurtenances included, complete, with manufacturer's name and model number.
- f) General arrangement and dimension drawings.
- g) Mounting details.

1.5 ELECTRICAL AND CONTROLS COORDINATION

- a. If the current requirement of any motor or piece of equipment is increased to such an extent that the wiring or conduit for the equipment must be increased from that shown on the electrical drawings, the Contractor shall furnish and install the larger items. In this case, the Contractor shall submit the proposed changes to the Engineer and obtain approval from the

Engineer and the Owner prior to installation. The increased wiring and conduit shall be provided at no additional cost to the Owner.

PART 2: PRODUCTS

2.1 GENERAL

- a. Furnish and install an 18-inch actuated valve for modulating service. The valve and actuator shall be sized for a maximum pressure drop of 4 psi and a 1.5 safety factor.

2.2 OPERATOR DESIGN

- a. Actuators shall contain motor, gearing, manual over-ride, limit switches, torque switches, drive coupling, integral motor controls, positioner for 4 – 20 mA input, analog position feedback 4 – 20 mA and mechanical dial position indicator.
- b. The motor shall be specifically designed for actuator service. The motor will be of the induction type with class F insulation and protected by means of thermal switches imbedded in the motor windings. Motor enclosure will be totally enclosed, non-ventilated, 15 minute duty motor.
- c. Motors voltage shall be [as shown on the electrical drawings](#), or as specified.
- d. Actuator enclosure shall be NEMA 6 suitable for temporary submerged service. All external fasteners on the electric actuator shall be stainless steel. Fasteners on limit switch and terminal compartments shall be captured to prevent loss while covers are removed.
- e. All gearing shall be grease lubricated and designed to withstand the full stall torque of the motor.
- f. Quarter-turn actuators shall be furnished with mechanical stops that restrict the valve/actuator travel. In addition, a visual position indicator showing valve open and closed positions.
- g. Manual over-ride shall be by handwheel. Manual operation will be via power gearing to minimize required rimpull and facilitate easy change-over from motor to manual operation when actuator is under load. Return from manual to electric mode of operation will be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation.
- h. Limit switches shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation. Limit switch drive shall be by counter gear. Limit switches shall be capable of quick adjustment requiring no more than five (5) turns of the limit switch adjustment spindle.
- i. A 4 Gear Train Limit Switch shall be provided. Two sets of normally open and two sets of normally closed contacts will be furnished at each end of travel. One set for motor control, the other set shall be for indication. With additional auxiliary limit to include two sets of normally open and two sets of normally closed contacts shall be furnished for intermediate positions of open and closed.

- j. Limit Switch ratings shall be 5 A at 250 VAC ind. load, 0.4 A at 250 VDC resistive load.
- k. Mechanically operated torque switches shall be furnished at each end of travel. Torque switches shall trip when the valve load exceeds the torque switch setting. The torque switch adjustment device shall be calibrated directly in engineering units of torque.
- l. All wiring shall be terminated at a plug and socket connector. A double seal shall be provided. The double seal connection is a sealed plug and socket which is fitted between the motor control housing and the plug/socket connector. Even after removing the plug cover or if the conduit is not sealed properly the device will be protected against the ingress of water and/or dust.
- m. Actuator must be capable of the following valve closing times/operating speeds: quarter-turn valves – 12" or less in size: 60 second closing time; 14" thru 24" 120 seconds; 26" thru 36" 180 seconds, or as specified
- n. Actuators shall be capable of operating in an ambient temperature range of –20 to +160 degrees F.
- o. Motor Controls, all actuators shall be furnished with integral motor controls consisting of reversing starters, control transformer, phase discriminator, monitor relay, "open-stop-close" pushbuttons, "local-off-remote" selector switch, in addition to red, green and amber indicating lights. Motor controls shall come complete with a lockable cover.
- p. An interface with the control system shall be furnished with optical isolators to separate incoming voltage signals from the internal motor controls.
- q. Positioner, the motor controls shall include a positioner to accept an input signal of 4 – 20 mA to position the valve accordingly. The actuator must be designed for modulating service and to be rated for a minimum of 1200 starts per hour.
- r. Output Contacts shall include the following;
 - 1) Selector switch in Local position
 - 2) Selector switch in Remote position
- s. Analog Output, the motor controls shall include a 4 – 20 mA analog output for continuous remote monitoring of valve position.
- t. All actuators shall be the SA/GS Series with Matic Motor Controls as manufactured by AUMA Actuators, Inc. of Canonsburg, PA.

2.3 PLUG VALVE

- a. The valve actuator shall be mounted to an 18-inch AWWA C517 eccentric rectangular full port plug valve in accordance with specification section 15100 Valves & Gauges.
- b. The valve shall have flanges drilled to ASME Class 125/150.
- c. The valve body shall be cast iron, ASTM A126, Class B, 150 psi pressure rating.
- d. The plug shall have a cylindrical seating surface eccentrically offset from the center of the shaft. Plug shall not contact the seat until at least 90% closed.
- e. Bearings shall be sleeve type and made of sintered, oil impregnated permanently lubricated type 316 stainless steel, ASTM A743 Grade CF8M through 36" (900mm).
- f. Bodies shall be Cast Iron ASTM A126 Class B. Ports shall be rectangular and 100% Port Area. The valve port area shall meet or exceed standard pipe area per ASME/ANSI B36.10M. Round ports are not acceptable.
- g. Resilient plug facing shall be chloroprene.
- h. Valve shall be a PEC, 16, F1, Cl, NBR, CR, 1304G0*X Modified valve as manufactured by Dezurik or approved equal.

PART 3: EXECUTION

3.1 GENERAL

- a. All mechanical portions of the installation shall comply with drawing details, the requirements outlined below, the manufacturer's latest recommendations and the best practices of the industry.

3.2 INSTALLATION

- a. Carefully handle and protect the equipment and appurtenances.
- b. Prior to installation, review all installation manuals provided with the equipment.
- c. In accordance with manufacturer's written instructions. Lubricate all required parts prior to mounting the operator to the valve. Mount and align the actuator as to provide a smooth stroke and no movement is detectable of the actuator body when the valve is operated.

3.3 PERFORMANCE TEST

- a. Conduct cycle tests on each valve/actuator assembly.
 - 1) Measure Voltage before and during cycle test
 - 2) Stroke Time (in seconds)
 - 3) Running Amps
 - 4) Seating Amps
 - 5) Verify limit switch operation
 - 6) Verify torque switch operation
 - 7) Verify full open and full closed positions.

3.4 INSPECTION, START-UP AND FIELD TESTING

- a. The Contractor shall furnish a representative of valve actuator manufacturer to perform inspection, startup and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment.
- b. The representative shall check the installation and supervise initial startup of the equipment. The representative shall conduct the performance testing noted above and prepare written documentation describing the results. They shall certify that the installation is correct and that the equipment has operated satisfactorily.
- c. After the installation and operation of the equipment has been certified, the manufacturer's representatives shall train the City's personnel for one 4 hour period in the proper operation and maintenance of the equipment. This training session shall be in addition to the required startup and testing services. Therefore, a minimum of two site visits will be required by the manufacturer.
- d. If the General Contractor fails to prepare all systems needed for the manufacturer's representative to perform all of the above testing, the representative shall make additional visits as required to complete the testing and training at no additional cost to the Owner.

PART 4: SPECIAL PROVISION

None.

SECTION 11287
WATER CONTROL GATES

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing stainless steel flow control sluice gates, stainless steel weir gates, operators, and accessories.
- b. A representative of the manufacturer of the water control gates shall provide oversight of the installation, inspect the installed equipment, and provide the certifications required herein.

1.2 MANUFACTURER

- a. The Contractor shall assign to a single manufacturer responsibility for furnishing and functional operation of the water control gates specified herein including operators and accessories. All components of the gates shall be of one manufacturer unless specifically shown otherwise. A single manufacturer shall supply all stainless steel gates specified in this section and shown on the drawings. Hand-pull slide gates may be supplied from a separate manufacturer. However, all stainless steel sluice and weir gates shall be supplied by a single manufacturer.
- b. The gate manufacturer shall furnish the service of a qualified representative to supervise and inspect the installation, start-up and field testing of the gates. A qualified manufacturer's representative shall be one who has had at least two years experience in the installation of the types of gates specified for this project.
- c. At the completion of the gate installation, the Contractor shall obtain written certification from the designated single manufacturer, addressed to the Owner, stating that the equipment will efficiently and thoroughly perform the required functions in accordance with these Contract Documents, and that the manufacturer has inspected the installation and finds that all gates are installed in accordance with the manufacturer's instructions.
- d. Operator training: The manufacturer's representative shall instruct the Owner's representative in the operation and maintenance of the equipment.
- e. Acceptable Manufacturers, or Equal
 - 1) H.Fontaine Ltd.
 - 2) Rodney Hunt Company
 - 3) Golden Harvest
 - 4) Hydrogate Corporation

1.3 QUALITY ASSURANCE

- a. Except as modified or supplemented herein, all gates and operators shall conform to the applicable requirements of AWWA C561, latest edition.

- b. The Contractor shall be responsible for coordination of the tests of each gate in the presence of the manufacturer's representative. Excessive leaks shall be corrected and the equipment retested until found satisfactory.
- c. All equipment furnished under this Section shall be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least 5 years. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.
- d. The manufacturer shall have experience in the production of substantially similar equipment, and shall show evidence of satisfactory operation in at least 50 installations. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of ASME, Section IX.
- e. Gates shall be shop inspected for proper operation before shipping. Test certificates shall be submitted.

1.4 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the following,
 - 1) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item).
 - 2) Shop drawings showing the detailed dimensions of the gate and accessories including placement of the operators in and around the various structures.
 - 3) Complete bill of materials for each gate assembly including a listing of all accessories provided.
 - 4) General construction and materials used in the gate and lift mechanism.
 - 5) Complete engineering design calculations in compliance with AWWA standards latest edition. Calculations shall include deflection calculations at the maximum expected head, calculations for the lifting force generated by 40 pounds effort on the handwheel or crank to operate the gate, and mounting hardware calculations.
 - 6) Factory test certificates.
 - 7) Field Procedures: Instructions for field procedures for installation, adjustments, inspection, and testing shall be provided prior to installation of the gates.
 - 8) Requirements for mounting hardware
 - 9) O&M Manuals: Complete technical manuals, including printed instructions for proper maintenance, lubrication, and complete parts list indicating the various

parts by name, number, and exploded view where necessary. A list of recommended spare parts.

PART 2: PRODUCTS

2.1 SLUICE GATES

- a. Sluice gates shall be of stainless steel construction.
- b. Performance: The leakage allowance for sluice gates under the design seating and unseating head shall not exceed 0.1 gpm/ft of seating perimeter or the leakage rate of AWWA C561, whichever is more stringent. The sluice gates shall be designed to withstand the design head shown in the schedule below.
- c. General Construction: Sluice gates shall be either self contained or non self contained of the rising stem, non rising or telescoping stem configurations as shown on the drawings and noted in the gate schedule below.
- d. Frame: The gate frame shall be constructed of structural members or formed plate welded to form a rigid one-piece frame. The frame shall be stainless steel ASTM A-240 304L or 316L. The frame shall be fabricated for mounting on a concrete wall, a round manhole, a wall thimble, or a standard flange as shown on the drawings and/or as noted in the gate schedule below. The frame shall be of the flush-bottom type and shall allow the replacement of the top and side seals without removing the gate frame from the concrete or wall thimble.
- e. Slide: The slide shall be stainless steel ASTM A-240 304L or 316L. The slide shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the gate's span under the design head.
- f. Guides and Seals: The guides shall be made of ASTM D-4020 UHMWPE (ultra high molecular weight polyethylene) and shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position. Side and top seals shall be made of UHMWPE of the self-adjusting type, or UHMWPE seats with separate resilient seals per AWWA C561-04. The sealing system shall maintain efficient sealing in any position of the slide and allow the water to flow only in the opened part of the gate. The bottom seal shall be made of resilient neoprene set into the bottom member of the frame or attached to the gate head and shall form a flush-bottom.

2.2 WEIR GATES

- a. Weir gates shall be of stainless steel construction. Weir gates shall be of the downward opening design and shall be face mounted as shown on the drawings.
- b. Performance. Weir gates shall be substantially watertight under the design head conditions. Leakage shall not exceed 0.05 U.S. gallon per minute per foot of seal periphery under the design seating head and 0.1 U.S. gallon per minute per foot (1.25 l/min per meter) of seal periphery for the design unseating head. Weir gates shall be designed to withstand the design head (maximum design head shall be taken as the height of the slide unless otherwise shown in the schedule).

- c. General Construction. Weir gates shall be either self-contained or non self-contained, and of the rising stem or non-rising stem configuration, as indicated on the gate schedule below.
- d. Frame. The gate frame shall be constructed of structural members or formed plate welded to form a rigid one-piece frame. The frame shall be of the flange back design, suitable for mounting on a concrete wall. The guide slot shall be made of UHMWPE (ultra high molecular weight polyethylene).
- e. Slide. The slide shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the gate's span under the design head.
- f. Guides and Seals. The guides shall be made of UHMWPE (ultra high molecular weight polyethylene) and shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position. The bottom and side seals shall be made of UHMWPE (ultra high molecular weight polyethylene) of the self-adjusting type or UHMWPE seats with separate resilient seals per AWWA C561-04. The sealing system shall maintain efficient sealing in any position of the slide and let the water flow only in the open part of the gate.

2.3 STEM AND COUPLINGS

- a. The operating stem shall be stainless steel ASTM A-240 304L or 316L designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40 lbs (178 N) effort on the crank or handwheel.
- b. The stem shall have a slenderness ratio (L/r) less than 200. The threaded portion of the stem shall have machined cut threads of the Acme type.
- c. Where a hydraulic, pneumatic or electric operator is used, the stem design force shall not be less than 1.25 times the output thrust of the hydraulic or pneumatic cylinder with a pressure equal to the maximum working pressure of the supply, or 1.25 times the output thrust of the electric motor in the stalled condition.
- d. For stems in more than one piece the different sections shall be joined together by solid couplings. The couplings shall be grooved and keyed and shall be of greater strength than the stem.
- e. Gates having a width greater than two times their height shall be provided with two lifting mechanisms connected by a tandem shaft.

2.4 STEM GUIDES

- a. Stem guides shall be fabricated from stainless steel ASTM A-240 304L or 316L. The guide shall be equipped with an ASTM D-4020 UHMWPE bushing. Guides shall be adjustable and spaced in accordance with the manufacturer's recommendation. The L/r ratio shall not be greater than 200.

2.5 STEM COVER

- a. Rising stem gates shall be provided with a clear polycarbonate stem cover. The stem cover shall have a cap and condensation vents and a clear mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.

2.6 LIFTING MECHANISM

- a. Manual operators of the types listed in the schedule below shall be provided by the gate manufacturer.
- b. Each manual operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 40 lbs (178 N) on the crank or handwheel, and shall be able to withstand, without damage, an effort of 80 lbs (356 N). Gearboxes shall be provided when required to maintain the operating force below 40 lbs.
- c. All bearings and gears shall be totally enclosed in a weather tight housing. The pinion shaft of crank-operated mechanisms shall be constructed of stainless steel and supported by roller or needle bearings.
- d. The crank shall be removable and fitted with a corrosion-resistant rotating handle. The maximum crank radius shall be 15 inches (381 mm) and the maximum handwheel diameter shall be 24 inches (610 mm). Operating nuts shall be standard 2-inch square nuts.

2.7 YOKE

- a. Self-contained gates shall be provided with a yoke made of structural members or formed plates. Materials shall be stainless steel ASTM A-240 304L or 316L. The maximum deflection of the yoke shall be 1/360 of the gate's span.

2.8 HAND-PULL SLIDE GATES

- a. General: The Contractor shall furnish and install hand-pull slide gates and frames as shown on the schedule and drawings. The gate and its guide frame shall be shipped with the gate in the guide and the assembly banded together thus forming a compact factory-aligned unit. Stop gates and guide frames shall be from a single manufacturer. The manufacturer shall submit calculations prior to fabrication demonstrating that the gate designs are suitable for the hydraulic conditions shown on the Drawings. Stop gates shall be Golden Harvest, Rodney Hunt, Waterman or equal. Allowable leakage shall not exceed 0.1 gpm per foot of gate opening perimeter. All parts of the gate shall have a minimum thickness of 1/4-inch.
- b. Materials
 - 1) The frame, disc, and invert shall be aluminum 6061-T6. Surfaces in contact with concrete shall be painted in accordance with Section 09900. Other surfaces shall be mill finish.
 - 2) Fasteners and anchor bolts shall be stainless steel type 304 or 316.
 - 3) Invert seal shall be neoprene ASTM D-2000.
 - 4) The seat shall be ultra high molecular weight polyethylene ASTM D-4020.

- c. Guides: Guides shall be of extruded aluminum with field replaceable high density polymer seats in dovetail slots on both sides of the disc. The invert of the frame shall be an angle welded to the bottom of the frame. A neoprene seal shall be attached to the angle and held in place with a bolted retainer bar. The guides shall be designed for maximum rigidity and shall have a weight of not less than 2-1 /2 pounds per foot.
 - 1) Mounting hardware shall be of size and type recommended by the manufacturer and shall be furnished as a part of the factory-drilled guide frame.
 - 2) Guide frames assembled from aluminum plate or structural shapes or which require field welding shall not be acceptable.
- d. Slide: The disc or sliding member shall be of aluminum plate reinforced with shaped aluminum extrusions welded to the plate not more than 16-inches apart. The disc shall not deflect more than 1/360 of the span of the gate, under the design head.
- e. Handles: Dual handles shall be provided for each gate.

2.9 MOUNTING HARDWARE

- a. All mounting hardware shall be stainless steel and shall be provided by the gate manufacturer. The gate manufacturer shall provide sizing calculations for the number, size and type of anchor bolts.

PART 3: EXECUTION

3.1 INSTALLATION

- a. Gates and appurtenances shall be handled and installed in strict conformance with the manufacturer's recommendations.

3.2 FIELD TESTS

- a. Following the completion of each gate installation, the gates shall be operated through at least two complete open/close cycles. If an electric or hydraulic operator is used, limit switches shall be adjusted following the manufacturer's instructions.
- b. Contractor shall test sluice gates by installing plugs and filling upstream structures. The rate of leakage shall be measured by noting the drawdown rate in the upstream structures. Any excess leakage shall be repaired until an acceptable test can be performed. The Contractor shall be responsible for coordinating the test with the Engineer and providing and installing the required plugs and providing the clean water for the testing.

PART 4: SPECIAL PROVISIONS

4.1 GATE SCHEDULES

- a. See the following pages.

Gate Number	201	202	203
Service	Wastewater, slide gate typically removed from channel	Wastewater, slide gate typically in place	Wastewater, slide gate typically in place
Location	Headworks main channel upstream of screen	Headworks bypass channel inlet	Headworks bypass channel outlet
Drawing Ref.	S221, S222, S223, M217, M218	S221, S222, S223, M217, M218	S221, S222, S223, M217, M218
Type	Hand Pull Slide Gate	Hand Pull Slide Gate	Hand Pull Slide Gate
Rising Stem	N/A	N/A	N/A
Opening Size	2 foot channel	2 foot channel	2 foot channel
Operator Type	None	None	None
Operator Mounting	N/A	N/A	N/A
Operating Floor Elevation (ft)	See drawings	See drawings	See drawings
Invert Elevation (ft)	See drawings	See drawings	See drawings
Slide Gate Height, floor to top (ft)	3 feet	3 feet	2 feet
Weir travel requirements	N/A	N/A	N/A
Max Seating Head (ft)	3 feet	3 feet	2 feet
Max Unseating Head (ft)	3 feet	3 feet	2 feet
Mounting	Embedded frame and guides	Embedded frame and guides	Embedded frame and guides
Remarks			

See next page for continuation of gate schedule

Gate Number	204	205	206
Service	Wastewater, flow splitting weir	Wastewater, flow splitting weir	Activated sludge, typically submerged, normally closed.
Location	Headworks flow splitter	Headworks flow splitter	SBR Partition Wall
Drawing Ref.	S221, S222, S223, M217, M218, M219	S221, S222, S223, M217, M218, M219	S205, M211, M212, M213
Type	Weir Gate	Weir Gate	Sluice Gate
Rising Stem	Yes	Yes	No
Opening Size	30 inch wide concrete weir	30 inch wide concrete weir	20" by 20" square blackout in concrete wall.
Operator Type	Manual, Handwheel	Manual, Handwheel	Manual, 2 inch nut
Operator Mounting	Self Contained	Self Contained	Wall bracket with nut below concrete walkway with cast in place cover in walkway
Operating Floor Elevation (ft)	See drawings	See drawings	See drawings
Invert Elevation (ft)	371.25 (concrete weir wall)	371.25 (concrete weir wall)	See drawings
Slide Gate Height, floor to top (ft)	N/A	N/A	N/A
Weir travel requirements	Full Down Position Elevation 371.50 ft Full Up Position Elevation 373.75 ft	Full Down Position Elevation 371.50 ft Full Up Position Elevation 373.75 ft	N/A
Max Seating Head (ft)	2.25 feet	2.25 feet	20 feet
Max Unseating Head (ft)	0 feet	0 feet	20 feet
Mounting	Concrete wall	Concrete wall	Concrete wall
Remarks	Bottom elevation of chamber in which gate is mounted = 369.00	Bottom elevation of chamber in which gate is mounted = 369.00	Provide operating nut placement and dimensions to general contractor for coordination of valve box casting.

See next page for continuation of gate schedule

Gate Number	207	208	209
Service	Effluent, typically open, intermittently submerged.	Effluent, typically open, intermittently submerged.	Effluent, open November 1 – April 30, closed May 1 – October 31.
Location	SBR decant box over EQ basin inlet	SBR decant box over EQ basin bypass pipe	EQ Basin flow control channel outlet over pipe to chlorine contact chamber
Drawing Ref.	S204, S205, S206, S212, S213, M211, M212, M213	S204, S205, S206, S212, S213, M211, M212, M213	S204, S205, S225, M212, M221
Type	Sluice Gate	Sluice Gate	Sluice Gate
Rising Stem	Yes. See remarks below.	Yes. See remarks below.	Yes
Opening Size	20" diameter Class 50 D.I. wall spool cast into concrete	20" diameter Class 50 D.I. wall spool cast into concrete	24" diameter Class 50 D.I. wall spool cast into concrete
Operator Type	Manual, 2 inch nut	Manual, 2 inch nut	Manual, Handwheel
Operator Mounting	Wall bracket with nut below decant box grating	Wall bracket with nut below decant box grating	Self Contained
Operating Floor Elevation (ft)	See drawings	See drawings	See drawings
Invert Elevation (ft)	See drawings	See drawings	See drawings
Slide Gate Height, floor to top (ft)	N/A	N/A	N/A
Weir travel requirements	N/A	N/A	N/A
Max Seating Head (ft)	16 feet	16 feet	8 feet
Max Unseating Head (ft)	4 feet	4 feet	2 feet
Mounting	Concrete wall	Concrete wall	Concrete wall, over pipe with embedded bottom frame
Remarks	Fabricate so that the rising stem is just below the grating in the fully open position. Furnish gate with a hollow operating wrench to allow access to the operating nut with the rising stem travelling through the hollow operating wrench. Provide operating nut placement and blockout dimensions to general contractor for coordination of grating blockout location.	Fabricate so that the rising stem is just below the grating in the fully open position. Furnish gate with a hollow operating wrench to allow access to the operating nut with the rising stem travelling through the hollow operating wrench. Provide operating nut placement and blockout dimensions to general contractor for coordination of grating blockout location.	Coordinate bottom frame embedment requirements with General Contractor. Coordinate vertical location of handwheel to avoid conflict with railing.

See next page for continuation of gate schedule

Gate Number	210	211	212
Service	Effluent, closed November 1 – April 30, open May 1 – October 31.	Lagoon supernatant water level control	Lagoon supernatant water level control
Location	EQ Basin flow control channel outlet over pipe to lagoon cell 2	Cell 1 to Plant Pump Station Supernatant Control Structure	Cell 1 to Cell 1 Supernatant Control Structure
Drawing Ref.	S204, S205, S225, M212, M221	S230, M230	S230, M230
Type	Sluice Gate	Weir Gate	Weir Gate
Rising Stem	Yes	Yes	Yes
Opening Size	24" diameter Class 50 D.I. wall spool cast into concrete	36 inch wide concrete weir	36 inch wide concrete weir
Operator Type	Manual, Handwheel	Manual, Handwheel	Manual, Handwheel
Operator Mounting	Self Contained	Self Contained	Self Contained
Operating Floor Elevation (ft)	See drawings	See drawings	See drawings
Invert Elevation (ft)	See drawings	346.00 ft (concrete weir wall)	346.00 ft (concrete weir wall)
Slide Gate Height, floor to top (ft)	N/A	N/A	N/A
Weir travel requirements	N/A	Full Down Position Elevation 346.00 ft Full Up Position Elevation 348.50 ft	Full Down Position Elevation 346.00 ft Full Up Position Elevation 348.50 ft
Max Seating Head (ft)	8 feet	4.5 feet	4.5 feet
Max Unseating Head (ft)	2 feet	2.5 feet	2.5 feet
Mounting	Concrete wall, over pipe with embedded bottom frame	Concrete wall	Concrete wall
Remarks	Coordinate bottom frame embedment requirements with General Contractor. Coordinate vertical location of handwheel to avoid conflict with railing.	Bottom elevation of chamber in which gate is mounted = 343.00 Coordinate vertical location of handwheel to avoid conflict with railing.	Bottom elevation of chamber in which gate is mounted = 343.00 Coordinate vertical location of handwheel to avoid conflict with railing.

Gate Number	301	302
Service	Effluent, open November 1 – April 30, closed May 1 – October 31.	Normally closed over bypass pipe.
Location	Chlorine contact chamber inlet box.	Chlorine contact chamber inlet box.
Drawing Ref.	S341,M341, M342	S341,M341, M342
Type	Sluice Gate	Sluice Gate
Rising Stem	Yes	Yes
Opening Size	24" diameter Class 50 D.I. wall spool cast into concrete	24" diameter Class 50 D.I. wall spool cast into concrete
Operator Type	Manual, Handwheel	Manual, Handwheel
Operator Mounting	Self Contained	Self Contained
Operating Floor Elevation (ft)	See drawings	See drawings
Invert Elevation (ft)	See drawings	See drawings
Slide Gate Height, floor to top (ft)	N/A	N/A
Weir travel requirements	N/A	N/A
Max Seating Head (ft)	6.5 feet	5.5 feet
Max Unseating Head (ft)	6.5 feet	2.0 feet
Mounting	Concrete wall, over pipe with embedded bottom frame	Concrete wall, over pipe with embedded bottom frame
Remarks	Coordinate bottom frame embedment requirements with General Contractor. Coordinate vertical location of handwheel to avoid conflict with railing.	Coordinate vertical location of handwheel to avoid conflict with railing.

SECTION 11301
SEQUENCING BATCH REACTOR EQUIPMENT

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

- a. Furnish, deliver, and install new and complete Sequencing Batch Reactor (SBR) Equipment. The Owner has entered into an equipment procurement contract with Xylem Water Solutions USA Inc. to provide the SBR equipment for this project. This equipment contract will be assigned to the Contractor as described in the Contract Documents.
- b. The Contract Documents for the SBR Equipment Procurement Contract are included in Appendix E of the Project Manual. These documents consist of the following.
 - 1) The Procurement Contract Between Xylem Water Solutions USA Inc. and the City of Aumsville.
 - 2) Change Orders to the Procurement Contract
 - 3) Partial Payments made by the Owner to Xylem Water Solutions USA Inc..
 - 4) Equipment and Product Submittals provided to the Owner by Xylem Water Solutions USA Inc..
 - 5) The proposal submitted by Xylem Water Solutions USA Inc. in response to the City's request for proposals.
- c. Prospective Bidders shall review the information provided in Appendix E of the Project Manual. It shall be the sole responsibility of the Bidders to verify the scope of the equipment package and the division of the scope of supply between Xylem Water Solutions USA Inc. and the Contractor. The Contractor shall be responsible for furnishing and installing a complete functional system. Ancillary items such as anchor bolts, pump and mixer guide bars, and all other appurtenances that are not furnished by Xylem Water Solutions USA Inc., shall be furnished and installed by the Contractor. All costs for the supply and installation of appurtenant items, coordination with Xylem Water Solutions USA Inc., taking delivery of the equipment, unloading the equipment, storage of the equipment per manufacturer's recommendations, handling and installation of the equipment, and startup of the equipment shall be included in the Contractor's Bid Price. No separate payment will be made for the failure of the Contractor to adequately determine these costs during the bidding process.

1.2 PROCUREMENT CONTRACT BACKGROUND INFORMATION

- a. The original procurement contract for the SBR equipment included a requirement that all equipment conforms to the Build American Buy American Act (BABA). After the Procurement Contract was signed, the City was granted a waiver from this requirement and a reduced price for the equipment package was negotiated. This change was formalized by the Change Order #1 to the Procurement Contract.
- b. The original Procurement Contract for the SBR equipment included equipment for Aerobic Digesters. After the Procurement Contract was signed, the City completed a value engineering study and determined that the digesters were not needed. Therefore, the digester equipment was removed from the Procurement Contract by Change Order #1.
- c. During the final design work various changes to the electrical control system furnished by Xylem were made and Change Order #2 was executed to document the additional costs of this work. Change Order #2 also included three additional davit cranes so that a crane could be installed at each of the WAS pumps and the Mixers rather than moving a single crane amount the four locations
- d. The City has made a single payment to Xylem Water Solutions USA, Inc. under the Procurement Contract in the amount of \$119,023.60. The total amount remaining to be paid under the SBR Procurement Contract including all Change Orders and deleting the remaining amount of the Buyer's Contingency Allowance is \$1,168,819.90. This amount shall be included in the Contractor's bid as noted in the Bid Form.
- e. The original Procurement Contract for the SBR equipment included a Buyer's Contingency Allowance. Some of this was used during the design process to modify the SBR equipment package. These adjustments to the Procurement Contract price are documented by the Change Orders listed in Appendix E. In accordance with Article 5.01.A.3.m of the Procurement Contract, any remaining continency allowance will cease to be operational and will no longer be included in the Procurement Contract after the Procurement Contract is assigned to the Contractor.

1.3 COORDINATION

- a. The Contractor shall cooperate with Xylem Water Solutions USA Inc. regarding the anticipated delivery dates for the SBR Equipment and these dates shall be designated and accommodated in the Contractor's construction schedule. The delivery dates are included in the Procurement Contract. See Appendix E.

1.4 MANUFACTURER CONTACT INFORMATION

- a. Manufacturer's Project Manager
Heidi Ruddy
Project Manager – Sanitaire

Xylem Water solutions USA, Inc.
980.416.8727
Heidi.Ruddy@xylem.com

- b. Manufacturer's Local Representative
Eric Hunter
Beaver Equipment
801.803.2082
erich@beaver-equipment.com

1.5 STORAGE, MAINTENANCE AND INSURANCE

- a. Subsequent to the assignment of the Procurement Contract, Contractor shall have complete responsibility for delivery, handling, and storage of the SBR Equipment.
- b. Store, protect, and maintain materials to prevent damage until final acceptance of completed work. The Contractor shall ensure the proper storage for all items in accordance with the manufacture's recommendations including items that must be stored in controlled environments (e.g., Motor Control Centers, Control Panels, Instruments, etc.). The Contractor shall provide storage accommodations for items that must be stored in controlled environments to the satisfaction of the Engineer at no additional cost to the City.
- c. The Contractor shall be responsible for replacing any lost or damaged products after assignment of the Procurement Contract to the Contractor with new, identical products.
- d. The Contractor shall include the items supplied under the SBR Procurement Contract in the Contractor's insurance coverage until project closeout. Evidence of insurance coverage shall be provided to Owner.

1.6 WARRANTY

- a. The Contractor's project warranty as described in Section 01750 shall cover and include, without exception, all materials and equipment furnished by Xylem Water Solutions USA Inc. including all coordination and management work required by the Contractor during the warranty period.

PART 2: PRODUCTS

2.1 SEQUENCING BATCH REACTOR EQUIPMENT PACKAGE

- a. The scope of the SBR equipment package is described in Proposal and Submittals provided by Xylem Water Solutions USA Inc. as included in Appendic C of the Project Manual.

PART 3: EXECUTION

3.1 INSTALLATION

- a. Equipment shall be installed by the Contractor in accordance with manufacturer's instructions.
- b. Layout and install the aeration equipment including support anchors in accordance with equipment manufacturer's recommendations and anchor setting plan. All equipment shall be anchored to floors or walls as appropriate.
- c. Level aeration system such that all diffusers connected to a header are within plus or minus 1/4 inch of a common horizontal plane.
- d. The Contractor shall coordinate equipment testing and start-up schedule with the Division 16 Subcontractor, Instrumentation and Control Subcontractor, the Engineer and the Owner.

3.2 ANCHOR BOLTS

- a. Contractor shall provide stainless steel anchor bolts as required to mount the equipment in accordance with the manufacturer's instructions. Contractor shall consult manufacturer for number, size, and type of anchor bolts during the bidding process. No additional payment shall be made to the Contractor for the Contractor's failure to coordinate mounting requirements during the bidding phase.

3.3 INSTALLATION, START-UP AND FIELD TESTING

- a. The Contractor shall furnish the services of the Manufacturer's field representative to advise on the installation, field testing, and startup of the equipment as specified in Section 11300 of the Equipment Procurement Contract (See Appendix E).

PART 4: SPECIAL PROVISIONS

None.

SECTION 11401
DISSOLVED AIR FLOATATION EQUIPMENT

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

- a. Furnish, deliver, and install new and complete Dissolved Air Floatation (DAF) Equipment. The Owner has entered into an equipment procurement contract with Krofta Technologies, LLC to provide the DAF equipment for this project. This Contract will be assigned to the Contractor as described in the Contract Documents.
- b. The Contract Documents for the DAF Equipment Procurement Contract are included in Appendix F of the Project Manual. These documents consist of the following.
 - 1) The Procurement Contract Between Krofta Technologies, LLC and the City of Aumsville.
 - 2) Change Orders to the Procurement Contract
 - 3) Partial Payments made by the Owner to Krofta Technologies, LLC
 - 4) Equipment and Product Submittals provided to the Owner by Krofta Technologies, LLC.
- c. Prospective Bidders shall review the information provided in Appendix F of the Project Manual. It shall be the sole responsibility of the Bidders to verify the scope of the equipment package and the division of the scope of supply between Krofta Technologies, LLC and the Contractor. The Contractor shall be responsible for furnishing and installing a complete functional system. Ancillary items such as anchor bolts and all other appurtenances that are not furnished by Krofta Technologies, LLC, shall be furnished and installed by the Contractor. All costs for the supply and installation of appurtenant items, coordination with Krofta Technologies, LLC., taking delivery of the equipment, unloading the equipment, storage of the equipment per manufacturer's recommendations, handling and installation of the equipment, and startup of the equipment shall be included in the Contractor's Bid Price. No separate payment will be made for the failure of the Contractor to adequately determine these costs during the bidding process.

1.2 PROCUREMENT CONTRACT BACKGROUND INFORMATION

- a. After the Procurement Contract was signed, the City utilized a portion of the Buyer's Contingency Allowance to complete on-site DAF simulations. This change to the contract was documented by Change Order #1 included in Appendix F.

- b. During the final design process, it was determined that several changes to the equipment package would be in the best interest of the City. These changes are noted below and the costs for these changes were documented by Change Order #2 to the contract.
 - 1) A second air compressor was added to improve system redundancy.
 - 2) The type of air compressors were changed from screw compressors to reciprocating air compressors.
 - 3) The sludge pump was changed to a diaphragm pump rather than a progressive cavity pump.
 - 4) The size of the air compressors was increased.
 - 5) The responsibility to provide seismic calculations for the various equipment items was added to Krofta's contract.
 - 6) Miscellaneous changes to the electrical control equipment were made to improve compatibility with the Owner's SCADA system.
 - 7) The pneumatic control valve on the tube flocculator was deleted.
- c. The City has made a single payment to Krofta Technologies, LLC under the Procurement Contract in the amount of \$82,211.10. The total amount remaining to be paid under the DAF Procurement Contract including all Change Orders and deleting the remaining amount of the Buyer's Contingency Allowance is \$660,190.90. This amount shall be included in the Contractor's bid as noted in the Bid Form.
- d. The original Procurement Contract for the DAF equipment included a Buyer's Contingency Allowance. Some of this was used during the design process. These adjustments to the Procurement Contract price are documented by the Change Orders listed in Appendix F. In accordance with Article 5.01.A.3.m of the Procurement Contract, any remaining contingency allowance will cease to be operational and will no longer be included in the Procurement Contract after the Procurement Contract is assigned to the Contractor.

1.3 COORDINATION

- a. The Contractor shall cooperate with Krofta Technologies, LLC regarding the anticipated delivery dates for the DAF Equipment and these dates shall be designated and accommodated in the Contractor's construction schedule. See Appendix F.

1.4 MANUFACTURER CONTACT INFORMATION

- a. Manufacturer's Project Manager
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Engineering Group Leader – Krofta
Xylem Water solutions USA, Inc.
Office +1 413 236 5634 ext. 20
Direct +1 413 822 7658
Mobile +1 413 281 2564
E-mail brian.trombley@krofta.com

1.5 STORAGE, MAINTENANCE AND INSURANCE

- a. Subsequent to the assignment of the Procurement Contract, Contractor shall have complete responsibility for delivery, handling, and storage of the DAF Equipment.
- b. Store, protect, and maintain materials to prevent damage until final acceptance of completed work. The Contractor shall ensure the proper storage for all items in accordance with the manufacturer's recommendations including items that must be stored in controlled environments (e.g., Motor Control Centers, Control Panels, Instruments, etc.). The Contractor shall provide storage accommodations for items that must be stored in controlled environments to the satisfaction of the Engineer at no additional cost to the City.
- c. The Contractor shall be responsible for replacing any lost or damaged products after assignment of the Procurement Contract to the Contractor with new, identical products.
- d. The Contractor shall include the items supplied under the DAF Procurement Contract in the Contractor's insurance coverage until project closeout. Evidence of insurance coverage shall be provided to Owner.

1.6 WARRANTY

- a. The Contractor's project warranty as described in Section 01750 shall cover and include, without exception, all materials and equipment furnished by Krofta Technologies, LLC including all coordination and management work required by the Contractor during the warranty period.

PART 2: PRODUCTS

2.1 SEQUENCING BATCH REACTOR EQUIPMENT PACKAGE

- a. The scope of the DAF equipment package is described in Proposal and Submittals provided by Krofta Technologies, LLC as included in Appendic D of the Project Manual.

PART 3: EXECUTION

3.1 INSTALLATION

- a. Equipment shall be installed by the Contractor in accordance with manufacturer's instructions.
- b. Layout and install the equipment including support anchors in accordance with equipment manufacturer's recommendations and anchor setting plant. All equipment shall be anchored to floors or walls as appropriate.
- c. The Contractor shall coordinate equipment testing and start-up schedule with the Division 16 Subcontractor, Instrumentation and Control Subcontractor, the Engineer and the Owner.

3.2 ANCHOR BOLTS

- a. Contractor shall provide stainless steel anchor bolts as required to mount the equipment in accordance with the manufacturer's instructions. Contractor shall consult manufacturer for number, size, and type of anchor bolts during the bidding process. No additional payment shall be made to the Contractor for the Contractor's failure to coordinate mounting requirements during the bidding phase.

3.3 INSTALLATION, START-UP AND FIELD TESTING

- a. The Contractor shall furnish the services of the Manufacturer's field representative to advise on the installation, field testing, and startup of the equipment as specified in Section 11400 of the Equipment Procurement Contract (See Appendix F).

PART 4: SPECIAL PROVISIONS

None.

SECTION 11620
EMERGENCY SAFETY SHOWER AND EYEWASH SYSTEM

PART 1: GENERAL

1.1 SCOPE

- a. Under this section the Contractor shall furnish and install the specified equipment and accessories required to complete the emergency safety shower and eyewash as shown on the drawings.
- b. The equipment shall include all appurtenances, shall be completely assembled and shall be arranged in a reasonable and operational fashion.
- c. All work performed under this section shall be in accordance with all approved trade practices and manufacturers' recommendations, including provisions for insulation between dissimilar metals where applicable.

1.2 SUBMITTALS

- a. Submittals shall conform to the requirements of these Contract Documents and shall include:
 - 1) The Contractor shall submit complete descriptive information on each item. This information shall define the quality of each item to be furnished.
 - 2) Shop drawings shall be submitted showing size and arrangement of all equipment and relation to adjacent work and material.
 - 3) Operation and Maintenance information

1.3 QUALITY ASSURANCE

- a. Manufacturer's names and catalog numbers listed in Part 2 are used to indicate quality and type of equipment to be furnished.

PART 2: PRODUCTS

2.1 COMBINATION SHOWER AND EYEWASH

- a. Combination safety shower and eyewash unit in accordance with ANSI Z358.1-2014 shall be located and plumbed as shown on the drawings. The unit shall be floor-mounted per manufacturer's recommendations.
- b. The shower head shall be a 10-inch diameter corrosion-resistant plastic or stainless steel, and shall be rated to deliver 20 GPM at 30 psi. The shower unit shall be provided with a shower head designed to maintain 20 GPM flow rate under varying pressures.
- c. The eyewash bowl shall be 11 1/8-inch diameter stainless steel.

- d. The spray head assemblies shall include flow control to assure safe, steady water flow under varying water supply conditions and pop-off protective spray head dust covers. The spray head shall be rated to deliver a minimum of 3 GPM at 30 psi.
- e. The shower valve shall be a 1-inch chrome-plated brass stay-open ball valve operated by a stainless steel pull rod and handle provided by the manufacturer.
- f. The eyewash valve shall be a ½-inch chrome-plated brass stay-open ball valve operated by a stainless steel push handle provided by the manufacturer.
- g. All pipe and fittings shall be 1 ¼ - inch galvanized steel protected with a factory finished yellow coating.
- h. The combination safety shower and eyewash shall be model G1909 as manufactured by Guardian, or approved equal.

2.2 FLOW SWITCH

- a. The unit shall be equipped with a flow switch used to activate an alarm signal when either the eyewash or the safety shower is in use. The flow switch shall be model SP154DPDT as manufactured by HAWS, or approved equal.

2.3 ELECTRIC TANKLESS HOT WATER HEATER

- a. Contractor shall furnish and install a commercial/industrial grade tankless hot water heater where indicated on the drawings and in accordance with manufacturer's instructions and in compliance with all rules and regulations of authorities having jurisdiction.
- b. The electric water heater shall have water connections on the bottom and be constructed with NSF 61 listed materials. Direct heating element to be non-ferrous, cartridge style, designed for field replacement. Tankless water heater to use a dual PID algorithm, actively managing power application to real-time system demand.
- c. Heater shall be compliant with ANSI Z358.1 tepid water without additional mixing or purge features.
- d. Water heater shall be Eemax SpecAdvantage AP048480 EFD or approved equal.

PART 3: EXECUTION

3.1 INSTALLATION

- a. All equipment shall be installed in accordance with the drawings, the manufacturer's recommendations and in compliance with all rules and regulations of authorities having jurisdiction.

3.2 INSPECTION

- a. All equipment shall be checked before acceptance. All dents, scratches, abrasions or other defects shall be repaired or equipment replaced if ordered.
- b. The combination safety shower/eyewash and thermostatic mixing valve shall be placed in operation and tested for satisfactory performance in accordance with the manufacturer's standards.

PART 4: SPECIAL PROVISIONS

None.

SECTION 11730
VERTICAL TURBINE PUMPS AND CANS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing vertical turbine pumping equipment and appurtenances for the Irrigation and DAF pump station as shown on the drawings and as scheduled in Part 4 and as specified herein.
- b. Vertical turbine booster pumps shall be manufactured according to ANSI/AWWA E101.
- c. The pumping equipment shall be furnished with all drives, drive shafts, couplings, pressure gauges, steady bearings, drive shaft guards, drive bases, pump bases, recommendations for anchor bolt, anchor bolt sleeves and other appurtenances as specified or required for a complete installation and satisfactory operation.
- d. All work performed under this section shall be in accordance with all approved trade practices and manufacturers' recommendations.
- e. A representative of the manufacturer of the pumps shall provide start-up services and training in the operation and maintenance of the equipment.
- f. Operation and maintenance manuals shall be provided for all equipment furnished and/or installed.

1.2 DEFINITIONS

- a. Total Head
 - 1) Total head (TDH) in feet of liquid pumped shall be the discharge head minus the suction head (or plus the suction lift) both measured at the pump flanges and corrected to pump datum as defined by Hydraulic Institute Standards, plus the difference in velocity head at the same points.
- b. Pump Efficiency
 - 1) Pump efficiency shall be the ratio of the useful power output at the discharge flange to the power input at the pump shaft.

c. Overall Efficiency

- 1) Overall efficiency shall be the total efficiency for motor and pump from the motor terminals to pumped liquid.

1.3 MANUFACTURER'S REPRESENTATIVE

- a. The pump manufacturer shall furnish the service of a qualified representative to supervise the installation, start-up and field testing of the pump and motor. A qualified manufacturer's representative shall be one who has had at least two years experience in the installation of the types of pumps specified for this project.
- b. At the completion of the pump installation, the following certifications shall be submitted as a minimum and included in the front of the O&M manuals.
 - 1) Certification letter signed by the manufacturer's representative stating the following as a minimum:
 - a) All required installation manuals were provided to the pump installer with the pump(s).
 - b) The installation is as specified and is acceptable to the manufacturer.
 - c) The warranty and/or guarantee will be in full effect during the warranty period with no qualifications or reservations.
 - 2) Certification letter signed by the pump installer stating the following as a minimum:
 - a) The installation and operations manuals were received with the pumps and appurtenances.
 - b) The installer has read the manufacturer's recommended installation procedures.
 - c) The pumps, equipment and appurtenances were installed in strict conformance with the specification requirements and the manufacturer's recommended installation procedures. Any variances shall be noted.
 - d) The bases were leveled with shims as required, and the shims were tack welded in place as specified before grouting.
 - e) The type of grout used.
 - f) The level/alignment was checked after the floor bolts were tightened and before the piping was connected.

1.4 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*ie. any proposed changes, substitutions or differences of any kind*), as well as marking these changes, substitutions or differences on each of the applicable submittal pages.
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:

1) Submittals for Record

- a) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item). This requirement applies to the pump cans but not the pumps.
- b) The Contractor shall submit an installation and operation certificate and a statement from the manufacturer as outlined above.
- c) Six (6) copies of certified test curves indicating capacity, head, efficiency, brake horsepower and speed shall be submitted to the Owner's Representative for inclusion in the O&M manuals.
- d) Complete operations and maintenance information for all pumps, motors and accessories, including manufacturer's warranties.
- e) Copies of all factory and field test reports, including pressure tests, vibration tests, etc. as applicable.

2) Submittals for Review

- a) Shop drawings including:
 - (1) Make, model, and weight of pumps and drivers.
 - (2) Complete specifications, descriptive drawings, and literature of the pumps, pump drives and baseplate.
 - (3) Completed copies of the data sheets in Part 4 of this section.

- (4) Shop drawings shall also include descriptive information as required to fully describe the pumps and overall performance and to state deviations, if any, from the specified requirements.
- (5) Technical data on stuffing box and seals as applicable, including descriptive drawings and pressure ratings.
- b) Each pump shall be shop tested in Accordance with standards of the Hydraulic Institute Level 2. Six (6) copies of certified test curves indicating capacity, head, efficiency, brake horsepower and speed shall be submitted to the Owner's Representative for approval. Computer model printouts are not acceptable. Testing of the pump assemblies using a factory test motor is acceptable. Test data sheets shall be submitted with the test curves.

The equipment manufacturer shall also indicate separately the head, capacity horsepower demand, overall efficiency and minimum submergence required at the guarantee point(s). No point on the pump performance curve shall require more than the nameplate horsepower of the drive motor.
- c) No pump shall be shipped to the job site until the above submittals have been approved by the Owner's Representative.
- d) Each pump shall be field tested after installation to certify that vibration is within the tolerances allowed by the latest version of the Hydraulic Institute Standards. Certification of satisfactory test results shall be submitted to the Owner's Representative.
- 3) Operations and Maintenance information, including parts lists for each piece of equipment, shall be submitted for all materials and equipment furnished under this and related sections.

1.5 ELECTRICAL AND CONTROLS COORDINATION

- a. If the current requirement of any motor or piece of equipment is increased to such an extent that the wiring, conduit and/or starter for that motor or equipment must be increased from that shown on the electrical drawings, the Contractor shall furnish and install the larger items. The increased wiring, conduit, and/or starter cost shall be provided at no additional cost to the Owner.
- b. All electrical, instrumentation, and control equipment and panels furnished under this section shall conform to appropriate sections of these Specifications. Equipment and panels shall be NEMA 4X or explosion proof unless otherwise specified or designated on the drawings.

- c. All electrical motors shall conform to the requirements of the applicable sections of these Contract Documents.

1.6 WARRANTY

- a. The pumps shall be warranted for a period of two full years from date of acceptance by Owner (ie. from date of substantial completion).
- b. In addition to the general warranty, all pump motors for which VFDs are provided shall include a 100% warranty (full parts & labor) against bearing damage or bearing failure due to VFD-induced shaft-to-bearing voltages and/or currents to ground via the bearings, for the life of the motor.

PART 2: PRODUCTS

2.1 GENERAL

- a. Each pump shall be designed and furnished to meet the operating conditions specified in Part 4 of this section.
- b. Each pump shall be of the manufacturer and model listed in Part 4 or equal. All pumps used for one type of service shall be of the same manufacturer.
- c. No point on the pump performance curve shall require more than the nameplate horsepower of the drive motor.

2.2 ANCHOR BOLTS

- a. Unless otherwise shown or approved by the Owner's Representative, anchor bolts to be stainless steel.
- b. The diameter, length and any bend dimensions of anchors shall be as shown on the drawings or as recommended by the equipment or machinery manufacturer, whichever is more stringent. Unless otherwise required or shown, use 3/4 inch minimum diameter and other geometry as shown on the drawings. In no case shall anchor bolts be more than 1/8-inch smaller than the anchor bolt holes provided by the manufacturer in the equipment or machinery.
- c. A minimum of two nuts and one washer of the same material as the bolt shall be furnished with each bolt. Sleeves shall be provided as required or as shown for location adjustment.

2.3 PUMP CONSTRUCTION:

- a. General

- 1) Pump(s) shall be water lubricated, open lineshaft design.
- 2) Major pump components fabricated of cast iron conforming to ASTM A48 Class 30, and shall have smooth surfaces devoid of blow holes and other irregularities.
- 3) All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings.

b. Discharge Head

- 1) Discharge head shall consist of a motor stand and above-ground discharge tee. The discharge head shall be fabricated steel with access windows for easy maintenance and removal of stuffing box without removing the motor, or approved equivalent.
- 2) The discharge head shall be designed to allow a vertical hollow shaft motor to be mounted above the stuffing box.
- 3) Discharge head shall have a Class 125 discharge flange of the size shown on the drawings. The discharge head shall be constructed with a vertical vane to minimize turbulence.
- 4) The pump discharge flange shall be drilled and tapped for a 0.50-inch NPT connection for a pressure gauge.

c. Mechanical Seals and Head Shaft

1) Mechanical Seal

- a) The mechanical seal shall be rated for a continuous operating pressure of 150 psi.
- b) The mechanical seal drain shall be piped to a drain or other discharge point with copper tubing. The copper tubing shall be minimum 3/8-inch ID or the size of the drain hole in the discharge head, whichever is larger.

2) Head Shaft

- a) The head shaft shall be two piece as follows:
 - (1) The head shaft extending through the stuffing box area shall be 416 stainless steel.
 - (2) The head shaft extending through the motor shall be high strength 416 stainless steel or equal.

b) Head Shaft Coupling

- (1) The head shaft coupling shall be of the threaded type with lock down design to guard against upthrust.
 - (2) Head shafts shall be sized to allow for a 25% loss in strength due to the keyway.
- c) The pump manufacturer shall include the method of adjusting the pump impellers at the top of the head shaft. This method shall provide a positive locking device.

d. Column Assembly

- 1) Column and shaft shall be provided by the pump supplier.
- 2) Pumps with speeds up to 2200 rpm shall have intermediate column lengths and lineshaft bearing spacing not to exceed 10 feet. Pumps with speeds between 2200 rpm and 3600 rpm shall have intermediate column lengths and lineshaft bearing spacing no greater than 5 feet. Column bearing shall be provided at all joints.
- 3) Column
 - a) The column shall be connected to the discharge head by a bolted flange. Flanges shall be parallel and true with the column centerline.
 - b) Column shall be steel pipe, ASTM A53, Grade A or approved equal and be sized for a maximum 5 feet/second velocity at the pump guarantee point.
 - c) The column shall be connected at all joints by threaded ductile iron ASTM A536, Grade 65-45-12 couplings. Maximum column pipe section lengths shall not exceed 10 feet. Column bearing shall be provided at all joints. The pipe shall have 1/8-inch taper 8 TPI and faced parallel to permit the ends to butt against the machined shoulders in the centering spiders.
- 4) Lineshaft
 - a) The lineshaft shall be 416 stainless steel, ground and polished. The shaft shall be of sufficient size to transmit full horsepower at any location on the pump curve, with an additional keyway allowance of 25%. The size of the shaft shall be no less than determined by ANSI/AWWA specification E101, section A-4.15 line shaft selection and shall be such that elongation due to hydraulic thrust will not exceed the actual clearance of the impellers on the pump bowls. They shall be furnished in interchangeable sections not over 10 feet in length. The butting faces shall be machined square to the axis of the shaft with the maximum

permissible axial misalignment of the threaded axis with the shaft axis .002 inch in 6 inches. Minimum shaft diameter shall be 1.50-inches.

- b) Shaft sections shall be interchangeable and shall not exceed 10 feet in length. The shaft ends shall be threaded and connected by couplings with a safety factor of 1.5 times the shaft safety factor. Threads shall be left hand tightened during operation.

e. Bowl & Impeller Assembly

- 1) Bowl castings shall be ASTM A48, Class 30 cast iron and shall be accurately machined with register fit circles. All bowls shall be flanged type construction. For pumps 8-inches and larger, the suction and intermediate bowls shall be fitted with replaceable wear rings of bronze, ASTM B505 alloy C90300. Wear rings shall have the minimum practical clearance to the mating cylindrical surface of the impeller to provide adequate sealing independent of the vertical positioning of the impellers.
- 2) Impeller (bowl) shaft shall be constructed from type 400 series stainless steel and not less than 1.94-inches in diameter. It shall be precision turned, ground and polished and shall be supported by water lubricated C84400 bronze bearings above and below each impeller.
- 3) Each impeller shall be a single piece enclosed ASTM B584 grade C87500 bronze casting. Semi-open impellers shall not be allowed.
- 4) Each impeller shall be secured to the impeller shaft by means of taper locks with 416 stainless steel lock collets.
- 5) Impellers shall be machined over the entire outer surface for efficiency considerations and shall be statically and dynamically balanced by grinding.
- 6) The impellers shall be laterally adjustable by means of a top shaft nut at the top of the motor.
- 7) The impeller shall be adjustable vertically by external means at the driver location.
- 8) Suction Bowl
 - a) The suction bowl shall be of the same material and lining as the pump bowls.
 - b) The suction bowl bearings shall be permanently grease packed ASTM B584 grade C84400 bronze. The suction bell bearing shall be protected by

a bronze or sand collar. The discharge case shall also contain an extra long support bearing.

9) Wear Rings

- a) Pumps with bowls diameters 8-inches and larger shall be fitted with replaceable wear rings of bronze material in the suction bowl and intermediate bowls. Wear rings shall have the minimum practical clearance to the mating cylindrical surface of the impeller to provide adequate sealing independent of vertical positioning of the impellers.

f. Protective coating

- 1) All bowls shall be lined with a porcelain or powder epoxy lined water passageways approved for potable water use.
- 2) Prior to assembly, the exterior of non-stainless components shall be sandblasted and painted at the factory with a suitable NSF approved coating for potable water with an epoxy base primer and top coating. Color shall be white Tnemec Pot Pox.
- 3) All damage to protective coating occurring during shipment or installation shall be repaired in the field using the same coating system as used in the factory. The pump shall be shipped with a minimum of 1 quart of top coating used for touchup in the field after installation.
- 4) Field painting of the pump and column pipe exterior shall be in accordance with the requirements of Section 09900, Painting.

2.4 MOTORS

- a. Motors shall conform to the requirements outlined below and in Division 16. In the case of conflicts, the more stringent requirements as determined by the Owner's Representative shall apply.
- b. Motors shall conform to electrical specifications as shown. The motors shall carry the thrust load of the pumps quoted. Horsepower, service factor, enclosure and other data must also be provided for the specific application. All motors should meet, as minimum requirements, the published standard rules and regulations of NEMA, ANSI and IEEE with respect to application, manufacture and test.
- c. Unless otherwise specified or shown on the drawings, all motors shall be wired for 3 phase 460 volt power as required.
- d. Motors shall be vertical solid shaft or vertical hollowshaft high thrust design, non-reverse ratchet locked down against upthrust, weather protected NEMA 1 type enclosure.

- e. Motors shall have a service factor rating of not less than 1.15. Motors shall be of sufficient horsepower to operate the pumps without overloading throughout the entire operating range of the pump without use of the service factor.
- f. Unless otherwise specified, all motors shall be premium efficiency with a minimum efficiency of not less than 93.8% from half load through full load.
- g. Motors shall have cast conduit boxes with grounding lugs and shall have conduit connections for the motor winding heat lines as specified as well as the power cables.
- h. Provide new bimetallic motor starter overload heaters as appropriate for the motor provided.
- i. All equipment shall be designed and built for industrial service and be capable of operating successfully under the following applicable conditions.
 - 1) 40°C maximum ambient temperature.
 - 2) Voltage variations to $\pm 10\%$ of nameplate rating.
 - 3) Frequency variations to $\pm 5\%$ of nameplate rating.
 - 4) Combined voltage and frequency variations to $\pm 10\%$ total, as long as frequency does not exceed $\pm 5\%$.
- j. Motor Bearings
 - 1) Thrust bearings shall be oil or grease lubricated, and a visual sight glass shall indicate oil level and condition.
 - 2) Thrust bearings shall have ample capacity to carry the weight of all the rotating parts plus the maximum hydraulic thrust of the pump impellers at shutoff head.

2.5 PUMP CANS

- a. The pump cans shall be a minimum of 16-inch OD fabricated using Schedule 40 steel pipe to the dimensions shown on the drawings including the flanged inlet connections. The cans shall be supplied by the pump manufacturer.
- b. The top plate of the can shall be drilled to match the pump head mounting plate bolt size and pattern. The pump can shall be furnished with a flanged inlet connection at the location and size shown on the drawings.
- c. Non-stainless components shall be sandblasted and painted at the factory with a suitable NSF approved coating for potable water with an epoxy base primer and top coating. Color shall be white Tnemec Pot Pox.

- d. All damage to protective coating occurring during shipment or installation shall be repaired in the field using the same coating system as used in the factory. The pump can shall be shipped with a minimum of 1 quart of top coating used for touchup in the field after installation.

PART 3: EXECUTION

3.1 GENERAL

- a. All mechanical portions of the installation shall comply with drawing details, the requirements outlined below, the manufacturer's latest recommendations and the best practices of the industry.

3.2 SHIPPING

- a. All components and parts shall be properly protected so that no damage or deterioration will occur during shipment. All pumping units shorter than 20 feet long shall be assembled as much as practical for shipment. Units longer than 20 feet should be shipped in the practical array of subassemblies.
- b. All openings such as suction and discharge flanges shall be covered with wood or metal blanks or properly sealed in plastic for shipment.
- c. To prevent damage during shipment, all drivers and mechanical seals will be installed at the job site.

3.3 INSTALLATION

- a. Carefully handle and protect the pump and appurtenances. If the pump and column are laid down, they shall be supported on blocks to prevent damage.
- b. Prior to installation, review all installation manuals provided with the pump(s). See Part 1.3(b) of this section for certification requirements relating to pump installation.
- c. Pump assemblies shall be installed such that they are properly aligned, plum and level. The column shall be straight and vertical when the installation is complete.
- d. Pump shall be leveled by means of steel wedges (steel plates and steel shims). Wedge taper shall not exceed ¼ inch per foot. Double wedges shall be used to provide a level bearing surface for the pump base. Secure each pair of wedges in their final position with tack welds on each side after leveling is complete.
- e. After the pumps have been set in position, aligned and shimmed to the proper elevation, grout space between the bottom of the base plates and the concrete foundation with a dry, tamped-in, non-shrinking grout.

- f. Install the pump so that connection may be made to the discharge header without springing or otherwise forcing either the pump or the header. All strain from attached piping shall be eliminated from the pumps. Any evidence of pump mis-alignment, noisy operation, leakage or other signs of improper setting shall be corrected by the Contractor.
- g. Coat all bolt threads with lubricant to facilitate future removal.

3.4 INITIAL LUBRICATION

- a. Initial lubrication required for start-up and field test operation shall be furnished and applied in accordance with the manufacturer's recommendations.

3.5 INSPECTION, START-UP AND FIELD TESTING

- a. The Contractor shall furnish a representative of the manufacturer to perform inspection, start-up and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment.
- b. The representative shall check the installation and supervise initial start-up of the equipment. He shall certify that the installation is correct and that the equipment has operated satisfactorily. This service shall be provided for a minimum period of one trip and one day for each pump startup required. In cases where pumps are installed and started sequentially, additional trips will be required.
- c. A performance test shall be required prior to acceptance of the installed pumps as outlined herein or under Division 16.
 - 1) The manufacturer's representative shall field adjust the impellers by the bronze top shaft nut to align the impellers within the bowls and maximize performance.
 - 2) Contractor shall demonstrate proper operation of the pumps at the guarantee point(s). Contractor shall furnish all instruments and labor required for this procedure. Units failing the field test shall be realigned and retested. If pump fails the second test, the unit will be rejected and the Contractor shall furnish a unit that will perform as specified.
- d. After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the Owner's personnel in the proper operation and maintenance of the equipment. This shall be in addition to the startup trips specified above.

PART 4: SPECIAL PROVISIONS

4.1 PUMP SCHEDULE

PUMP SCHEDULE								
Pump No.	Location	Speed RPM	Motor Size HP	No. of Stages	Capacity & Efficiency GPM @ TDH (ft)			Make & Model
					GPM	TDH	% EFF.	
P-1	Irrigation Pump #1. See Drawings	1770	40	3	300	180	63	Goulds VIC-FLFM 11CMC
					600	160	84	
					800	130	80	
P-2	Irrigation Pump #2. See Drawings	1770	40	3	300	180	63	Goulds VIC-FLFM 11CMC
					600	160	84	
					800	130	80	
P-3	DAF Pump #1. See Drawings	1770	5	1	200	40	65	Goulds VIC-FLTM 9RCLO
					400	32.5	82	
					500	25.5	77	
P-4	DAF Pump #2. See Drawings	1770	5	1	200	40	65	Goulds VIC-FLTM 9RCLO
					400	32.5	82	
					500	25.5	77	

PUMP DATA SHEET

SUPPLIER'S NAME _____ DATE _____

PUMP DATA

MANUFACTURER _____

MODEL NUMBER _____

RPM _____

NUMBER OF STAGES _____

NOMINAL SIZE OF BOWLS _____

MAX. OD OF BOWLS _____

OVERALL LENGTH BOWL SECTION _____

PUMP SHAFT DIAMETER _____

PUMP SHAFT MATERIAL _____

TYPE LUBRICATION _____

NO. OF PUMP BEARINGS _____

PUMP BEARING MATERIAL _____

DESCRIPTION OF PUMP BEARINGS _____

PUMP BOWL CATALOG NUMBER _____

PUMP BOWL MATERIAL AND LINING _____

IMPELLER TYPE (e.g. OPEN, CLOSED) _____

IMPELLER NUMBER _____

IMPELLER MATERIAL _____

HP DEMAND AT GUARANTEE POINT(S) _____

PUMP EFFICIENCY AT GUARANTEE POINT(S) _____

SECTION 11750
SUBMERSIBLE SEWAGE PUMPS

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing pumping equipment and appurtenances within and adjacent to the Plant Pump Station wetwell, as shown on the drawings or as specified herein, including all configuring and startup work for a complete and operable system.
- b. The pumping equipment shall be furnished with all motors, power cables, pump bases, guide bars & brackets, discharge piping, fittings, anchors, anchor bolts, anchor bolt sleeves and other appurtenances as specified or required for a complete installation and for satisfactory operation, including all pump removal components specified herein.
- c. Minimum to be Included in Pump Supplier Scope of Supply. In addition to the pumping equipment & appurtenances specified herein, the pump supplier shall also furnish the following items to provide a completely integrated system.
 - 1) Pumps & Appurtenances. Per drawings and this specification section, including but not limited to guide bar brackets.
 - 2) FRP Wetwell Sump Insert. See drawings and specification 11751.
- d. The scope of items which must be provided by the pump manufacturer under this section does **NOT** include the following items (*although the applicable items below can be provided by the pump supplier if desired*).
 - 1) Pump Control System. Unless otherwise shown on the drawings or specified otherwise, the Pump Control Panel is being furnished by the Owner for installation by the Contractor.
 - 2) Power conduits, control conduits and wiring. Reference the Electrical Drawings & Specifications for work by Contractor which is not under this section.
 - 3) Electrical receptacles, luminaires, instruments and associated conduit & wiring (*other than the pump cable disconnect plug/receptacles specified herein*).
 - 4) Air Gap / Disconnect Panel Stand(s). The support stand for the pump disconnect panel(s) (*this can be provided by the pump supplier or provided separately, at the Contractor's option*).
 - 5) Pump discharge piping, fittings & guide bars as specified herein are not required to be provided by the pump manufacturer.
 - 6) Wetwell hatch. See drawings and specification 11751.
 - 7) Cable tray. See drawings and specification 11751.
 - 8) Control Shelter/Building. See drawings and specification Section 06605.
- e. Programming by City/Owner. Unless otherwise noted on the drawings or in Division 13/16, the City will provide the following (*Contractor shall remain fully responsible for coordinating with the City's SCADA integrator to ensure that this can be completed without delay to the work*):
 - 1) Programming and integration of the telemetry panel PLC, radio modem, and all network hardware within the telemetry panel.
 - 2) SCADA system programming as required.
- f. A representative of the manufacturer of the pumps shall provide programming & start-up

services, and training in the operation and maintenance of the equipment (*ie. training of the Owner's personnel*).

- g. All Work performed under this section shall be in accordance with all approved trade practices and manufacturers' recommendations, including provisions for insulation between dissimilar metals where applicable.

1.2 DEFINITIONS

- a. Total Head: Total head (*TDH*) in feet of liquid pumped shall be the discharge head minus the suction head (*or plus the suction lift*) both measured at the pump flanges and corrected to pump datum as defined by Hydraulic Institute Standards, plus the difference in velocity head at the same points.
- b. Pump Efficiency: Pump efficiency shall be the ratio of the useful power output at the discharge flange to the power input at the pump shaft.
- c. Overall Efficiency: Overall efficiency shall be the total efficiency for motor and pump from the motor terminals to pumped liquid.

1.3 PUMP MANUFACTURER'S REPRESENTATIVE

- a. The pump manufacturer shall furnish the service of a qualified representative to supervise the installation, start-up and field testing of the pump and motor. A qualified manufacturer's representative shall be one who has had at least two years experience in the installation of the types of pumps and controls specified for this Project.
- b. At the completion of the pump installation, the following certifications shall be submitted as a minimum and included in the front of the O&M manuals.
 - 1) Certification letter signed by the manufacturer's representative stating the following as a minimum:
 - a) All required installation manuals were provided to the contractor along with the pump(s), level controls, etc.
 - b) The installation, configuration & programming is as specified and is acceptable to the manufacturer.
 - c) The warranty and/or guarantee will be in full effect during the warranty period with no qualifications or reservations.
 - 2) Certification letter signed by the pump installer stating the following as a minimum:
 - a) The installation and operations manuals were received with the pumps and appurtenances.
 - b) The installer has read the manufacturer's recommended installation procedures, and coordinated with the pump supplier to be present when the pumps are installed, started up and tested.

- c) The pumps, equipment and appurtenances were installed in strict conformance with the specification requirements and the manufacturer's recommended installation procedures. Any variances shall be noted.
- d) The bases and guide bars were leveled and plumbed as required before grouting.
- e) The plumbness of the guide bars was checked after the anchor and mounting bolts were tightened before the pumps were installed.

1.4 WARRANTY

- a. Pumps. In addition to the general warranty required for the project, the pump manufacturer shall furnish the Owner with a written warranty to cover the pump(s) and motor(s) against defects in workmanship and material for a period of five (5) years or 10,000 hours of operation. Pumps repaired under warranty will be returned to the Owner freight prepaid.

The pump manufacturer will pay the following portion of the cost of all replacement parts and labor based on the time elapsed from shipment of the pump unit to the site.

Months	0-18	19-39	40-60
Hours	0-3,000	3,000-6,500	6,500-10,000
Warranty	100%	50%	25%

Pump Motor Bearings with VFDs. In addition to the general pump & motor warranty, all pump motors for which VFDs are provided shall include a 100% warranty (*full parts & labor*) against bearing damage or bearing failure due to VFD-induced shaft-to-bearing voltages and/or currents to ground via the bearings, for the life of the motor.

1.5 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*ie. any proposed changes, substitutions or differences of any kind*), as well as marking these changes, substitutions or differences on each of the applicable submittal pages.
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the following.
- c. Submittals for Review (**Pumps**).

1) Pump and piping submittals & shop drawings including:

- a) Cover letter from the pump manufacturer summarizing the following information as a minimum.
 - (1) make & model of pumps and motors.
 - (2) motor HP and speed.
 - (3) motor efficiency meets specification requirements.

- (4) For wet-pit pumps:
 - (a) weight of each pump/motor unit (*in pounds*), excluding pump cables.
 - (b) weight of each pump/motor unit (*in pounds*), including pump cables.
 - (5) Written statement that pumps will meet or exceed each of the specified duty points (*ie. specified discharge/head requirements*).
- b) Pump performance curves and performance chart showing curves and data for flow, head, torque, current, power factor, input/output kW, horsepower and efficiency for the pump motor (*demonstrating that each pump will meet or exceed the specified flow at the specified duty point(s). If average pump performance curves are used, the pump supplier shall account for potential bilateral test tolerances based on the type of HI factory test method proposed for use by the manufacturer*). These curves or charts shall also include data on starting and no-load characteristics.
 - c) Complete specifications, descriptive drawings, and literature of the pumps, pump drives, mounting systems, etc., including manufacturer's descriptive information as required to fully describe the pumps and overall performance, and to state deviations, if any, from the specified requirements.
 - d) Technical data on seals, including descriptive drawings and pressure ratings.
 - e) Stainless Steel Basket Cable Grips. Technical data and/or literature on the required basket cable grips specified to support the upper ends of the pump power & signal cables (*minimum of 2 basket cable grips required per power cable, control cable or signal cable installed in the wetwell*).
 - f) Typical installation guides and technical manuals.
 - g) Manufacturer's storage recommendations and recommended start-up report form.
 - h) Copy of proposed manufacturer's warranty.
 - i) Pump Removal Components. Drawings and literature covering the specified pump removal system(s) to be provided by the manufacturer, including the following.
 - (1) Size & length of the stainless steel lifting chain sling and how it is to be connected to the pump lifting handle.
 - (2) Grip-eye for each size of pump, as specified.
 - (3) Any specified pump removal hook/eye assembly (*for use with jib crane or with pump removal boom truck*).
 - j) FRP wetwell sump insert (*if the sump is provided by the pump manufacturer*), including installation instructions & procedures (*see requirements on drawings & section 11751*).

- k) Anchor Bolts for Pump Discharge Elbow.
- (1) Standard Anchor Bolt Information. Complete specifications, descriptive drawings, and literature for the standard cast-in-place anchor bolts (*J bolts*) recommended/required by the manufacturer for the pumps being provided, including diameter, embedment length, material, etc.
 - (2) Alternate Wetwell Pump Anchor Bolts. Unless otherwise specified or noted as prohibited on the drawings, epoxy anchor bolts may be proposed for use with wetwell pumps at the option of the Contractor & pump supplier, based on submittal of information regarding threaded rod material & diameter, embedment depth, drill hole size, and type of epoxy for use. Epoxy anchor bolts proposed for wetwell pumps shall at least equal to the standard manufacturer recommended J or plate anchor bolts (*including bolt diameter/size, material, embedment depth, etc., for which submittal information is also required*).
- 2) Factory Pump Tests (prior to shipment). A written quality assurance record and report (*documenting the results of the following inspections/testing performed*) shall be provided for each pump prior to shipment from the factory.

No pump shall be shipped to the job site until the submittal information below has been approved by the Owner's Representative.

- a) Each pump shall be hydraulically shop tested in accordance with standards of the Hydraulic Institute, demonstrating that each pump meets or exceeds specified flow at the specified duty point(s), regardless of the HI test standard used for the factory tests.
- (1) Each pump shall be run submerged in water (*6 foot minimum*) for a minimum of 15 minutes.
 - (2) Copies of certified test curves indicating head versus capacity, efficiency, brake horsepower and speed shall be submitted to the Engineer for review & approval prior to shipping the pumps from the factory. Test data sheets shall be submitted with the test curves, and the test results/curves shall be labeled with the applicable pump information, including make & model of the pump, impellor, motor size, motor speed, motor efficiency rating, etc.
 - (3) All test results, curves, etc. shall be labeled to indicate the model number of the pump, impellor and motors tested (*including motor HP and efficiency rating*), and the job name for which the pumps are being supplied.
 - (4) Computer model printouts are not acceptable (*actual test results are required*).
 - (5) **Written confirmation from the pump supplier** that the pumps meet or exceed each of the specified duty points, including at shut-off head.
The equipment manufacturer shall also indicate separately with the test results the head, capacity horsepower demand, overall efficiency and minimum submergence required at the guarantee

point(s).

No point on the pump performance curve shall require more than the nameplate horsepower of the drive motor.

- (6) Motor and cable insulation shall be tested for moisture content or insulation defects before and after the factory pump testing.

d. Submittals for Review (*Air Gap Stands for Pump Disconnect Panel(s) or Junction Panel(s)*).

- 1) Shop drawings & literature, information and materials of construction for all required air gap panel stands to support the pump disconnect panel(s) or junction panel(s).
- 2) Required. Submittals shall indicate whether the air gap panel stands are being provided by the Contractor or by the pump manufacturer.
- 3) Approval Timing Note: Submittals for the air gap panel stands supporting the Pump Disconnect Panel(s) or Junction Panel(s) will not be approved prior to submittal and approval of the associated panels/enclosures which will be mounted on the applicable air gap stands.

e. Submittals for Review & Record (*As-Built Information*).

- 1) Pump Station Site & Force Main, As-built Survey & Record Drawings.
 - a) Prior to pump station startup, the contractor shall provide copies of as-built record drawings for the pump station site improvements, the wetwell & vaults, water/sewer/storm services, force main, etc. *(based on an as-built survey to establish finish grades and rim/pipe invert elevations at the wetwell, vault(s) and manholes on or adjacent to the pump station site).*
 - (1) Maintain Copy of Field Record Drawings at PS Site until As-builts are Finalized. A color copy of the Contractor's field record drawings shall be maintained at the pump station site for reference until the final approved as-builts have been prepared and submitted to the Owner.
 - b) Written certification by the Contractor's surveyor that existing survey monuments around the pump station site and along the force main or utility alignments were not disturbed, or that disturbed monuments were reset and notification filed with the County Surveyor.
- 2) Installation certificate and statements from the manufacturer(s) and installer(s) as outlined herein, for inclusion in the O&M manuals.
- 3) Copies of certified test curves indicating capacity, head, efficiency, brake horsepower and speed, for inclusion in the O&M manuals.
- 4) Copies of all factory test reports, including pressure tests, vibration tests, etc. as applicable, for inclusion in the O&M manuals.

- 5) Copies of field pump startup & test results shall be provided for inclusion in the O&M Manuals, including results and certification of the following.
 - a) Impeller, motor rating and electrical connections were checked for compliance with this and related specifications.
 - b) A motor and cable insulation test for moisture content or insulation defects was made.
 - c) Prior to submergence, each pump shall be run dry to establish correct rotation.
 - d) Results of a drawdown test of the wetwell with each pump operated separately.
 - e) After the drawdown (*operational*) test (d), the insulation test (b) is to be performed again.
- 6) Complete information on all specified pump removal components, as well as certifications and/or test certificates.
 - a) Chain slings connected to pump handle
 - b) Grip-Eye
 - c) Pump removal hook/eye assembly
- 7) O&M Manuals - Operations and Maintenance information, including parts lists and complete manufacturer's literature for each piece of equipment, shall be submitted for all materials and equipment furnished under this and related sections, including printout of any programming and/or setpoints for controllers or other programmable equipment (*after startup*), including VFDs.

PART 2: PRODUCTS

2.1 ANCHOR BOLTS FOR PUMP DISCHARGE BASES

- a. All anchor bolts for pump discharge bases shall be 316 stainless steel.
- b. The diameter, length and any bend dimensions of anchors shall be as shown on the drawings or as recommended by the equipment manufacturer, whichever is more stringent. Sleeves shall be provided for location adjustment as required by the manufacturer or as shown on the drawings or submittals.
- c. Unless otherwise required or specified, use 3/4 inch minimum diameter bolts with geometry as shown on the drawings. In no case shall anchor bolts be more than 1/8-inch smaller than the anchor bolt holes provided by the manufacturer of the equipment or machinery.
- d. Wedge anchors, threaded screw anchors, self-drilling anchors, or powder activated fasteners are not permitted and shall not be used for pump base anchor bolts.
- e. Epoxy Threaded Anchor Rod Option. If drilled & epoxied threaded anchor rods are used for wetwell pumps, as proposed by the Contractor or the pump supplier, the size and embed depth of the stainless steel threaded rods shall meet or exceed the size and embed depth of the standard anchor bolts recommended/required by the pump manufacturer (*or as shown on the drawings*), for the specific pumps being provided, and based on the following.
 - 1) Epoxy adhesive for use with the 304 stainless steel threaded anchor rods shall be

- Simpson SET-3G High-Strength Epoxy Adhesive.
- 2) The size of the hole in the concrete shall be in conformance with the manufacturer's recommendations (*typically 1/8" larger than the threaded rod diameter*).
 - 3) Installation shall fully conform with the manufacturer's recommendations, including hole cleaning & epoxy installation.
 - 4) Contractor shall be responsible for coordinating all inspections and special inspections required for such drilled & epoxied threaded anchor rods by applicable building codes.
 - 5) Contractor shall ensure that anchor bolts are not disturbed until epoxy is fully cured (*see SET-3G cure schedule, typically varies from 24 to 72 hours, depending on concrete temperature*), by either do not allowing entry into the wetwell for the entire cure time, OR by providing secure anchored covers over the anchor bolts to ensure that they are not accidentally disturbed.
- f. If configurations are proposed which are different from the manufacturer's cast-in-place bolt recommendations, or if configuration proposed is other than the drilled & epoxied option listed above, calculations shall be provided (*by a licensed structural engineer retained by the pump supplier or Contractor*) showing that the proposed anchor bolt system is structurally equivalent to the standard J anchor bolts recommended / required by the manufacturer (*or as shown on the drawings*), for the specific pumps being provided.
- g. Double Nuts. A minimum of two nuts and one washer of the same material as the bolt shall be furnished with each bolt, with both nuts being fully engaged on the anchor bolt threads and fully tightened to lock the nuts in place.

2.2 PUMP ACCESSORIES

a. Pump Discharge Connection

- 1) Each pump shall be provided with a mating cast iron discharge connection by the same manufacturer as the pump, and designed to be bolted to the wetwell floor. The pump shall be completely supported by the discharge head. No portion of the pump shall bear directly on the wet well or sump floor.
- 2) For wetwells where a prefabricated fiberglass bottom sump basin is specified or shown on the drawings, the discharge connection shall be specifically designed for installation at the mounting locations shown on the prefabricated sump basin.
- 3) Guide Bar Vibration Dampener. A vibration dampener shall be provided for each guide rail (*guide bar*), installed between the pump discharge connection elbow and the bottom of the guide rails.

b. Pump Lifting Handle:

- 1) The pump shall be provided with a galvanized steel lifting handle for connection of the pump removal system, or for direct removal by a lifting hook.

c. Guide Rail System (Pump Guide Bar System)

- 1) Each pump to be furnished with a guide rail system consisting of dual guide rails

(ie. *guide bars*) extending from the pump discharge connection elbow to the upper guide bar bracket which is mounted to the wetwell access hatch skirt or frame.

- 2) The guide bars shall consist of Type 304 schedule 40 stainless steel pipe, diameter as required for the specified pumps (*2" or 3" diameter as applicable*). The stainless steel guide bar pipe shall be continuous along its length, except where connecting to intermediate guide bar brackets as noted below (*ie. intermediate guide bar brackets act as a splice in the guide bars at the bracket location, for guide bars longer than 20 feet*).
- 3) The guide rail system shall include a Type 316 stainless steel upper guide bar bracket, as well as Type 316 stainless steel intermediate guide bar bracket(s) as specified below, at intervals as recommended by the pump supplier or as shown on the drawings.
 - a) The maximum guide bar length between the discharge head and the first intermediate guide bar bracket shall be 20 feet (*this same 20 foot maximum length limit applies between multiple intermediate guide bar brackets, or between an intermediate guide bar bracket and the upper guide bar bracket*).
 - b) Height to First Intermediate Guide Bar Bracket. Unless otherwise specifically shown on the drawings, the first intermediate guide bar bracket shall be set 20 feet above the pump discharge head (*in order to minimize the risk of debris buildup on the bracket in the event of a wetwell surcharge event*).
- 4) The guide rail system shall be designed and installed to locate the pumps in the proper alignment for automatic connection of the pumps to the discharge head, with the guide bars installed plumb unless otherwise specifically shown or noted on the drawings.
- 5) All brackets, braces, guides and fittings necessary for a complete working guide rail system shall be provided and installed by the Contractor.

d. Grip-Eye Pump Removal System

- 1) Each pump shall be equipped with complete attachments necessary for lifting the pump and motor from the wetwell by means of the Flygt Grip Eye system. The working load of the Flygt Grip Eye lifting system shall be a minimum of 50% greater than the pump unit weight.
- 2) The lifting system accessories shall be as specified, or as shown or noted on the drawings, and shall include a minimum 16-inch long standard stainless steel chain lifting sling, enough ¼-inch diameter woven nylon rope to reach from the installed position of the pump to an anchor point under the wet well access hatch, clevises, bolts and all other attachments necessary for a complete system.
- 3) Two Flygt Grip-Eye units shall be provided for each size of pump at the pump station.

e. Pump Removal Hook/Eye Assembly

- 1) In addition to the Flygt Grip Eye, each pump station shall be provided with a pump retrieval hook/eye assembly, in order to allow connection directly to the pump lifting bail (*when the wetwell can be pumped down below the top of the pumps*).
- 2) Contractor shall verify that the hook proposed is sized to fit around the lifting handle of all pumps at the pump station.
- 3) The hook/eye assembly shall consist of a wide-throat style “eye foundry hook”, a master link, and a closed ring sized for connection to the hook on the pump hoist (*the hook/eye assembly shall as short as feasible, with maximum length not to exceed 18”, unless a longer length is specifically noted on the drawings*).
- 4) When a jib crane is provided at the pump station site, the working load of the hook/chain/eye assembly shall be equal to or greater than 125% of the jib crane load rating, and shall be proof tested and certified by the supplier.
- 5) The pump retrieval hook/chain/eye assembly shall consist of the following, or approved equal.
 - a) The pump retrieval hook shall be Crosby A-1329 Eye Foundry Hook, Stock# 1026297 or equal (*3.5” min hook throat opening*).
 - b) Suncor SS hammerlock link, Stock# S0655-0013.
 - c) Suncor SS 1” master link, Stock# S0650-0025.
- 6) Field demonstration & testing.
 - a) The Contractor shall be responsible to demonstrate (*with the Owner’s Representative and Owner’s operations staff present*) use of the hook/eye assembly to remove each of the pumps at the pump station, without entering the wetwell, with lift equipment provided by the Contractor.
 - b) When a jib crane is provided at the pump station site, the Contractor shall verify the length on the hook/eyes assembly to ensure that the pump will clear the wetwell hatch when lifted by the onsite lifting crane.

2.3 PUMP DISCHARGE PIPE & FITTINGS, PIPE BRACKET ANCHORS

- a. Discharge piping & fittings inside the wetwell shall be as noted on the drawings and/or as specified in Division 15.
- b. All anchors, anchor bolts, harnesses & fasteners inside the wetwell (*or fastened to the outside of the wetwell*) shall be 304 stainless steel, unless 316 stainless steel is specified for particular equipment or locations.
- c. Anchor bolts for pump discharge bases shall be as specified above.

2.4 SUBMERSIBLE PUMPS

- a. All pumps used for one type of service shall be by the same manufacturer. The pump, mechanical seals and motor units provided shall be from the same manufacturer in order

to achieve standardization of operation, maintenance, spare parts, service and warranty.

- b. Pumps shall be submersible sewage pumps as manufactured by Xylem Flygt Corporation, or approved equal. Pump models shall be as noted on the drawings or as specified in the Pump Schedule under Part 4 of this section.

- c. General Requirements

- 1) Pumps shall be heavy duty, electric submersible, centrifugal non-clog units designed for handling raw, unscreened sewage and wastewater and shall be fully guaranteed for this use.
- 2) Wet-Pit Pumps. The pump and motor unit shall be suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged, or while totally non-submerged. The use of shower systems, secondary pumps or fans to cool the motor shall not be acceptable.
- 3) The pumps provided shall be capable of operating in an ambient liquid temperature of 104°F. Since the high temperature of 104°F is specified by the National Electrical Manufacturers Association (NEMA) and Factory Mutual (FM), motors with a maximum ambient temperature rating below 104°F shall not be acceptable.
- 4) No point on the pump performance curve shall require more than the nameplate horsepower of the drive motor.
- 5) Each pump shall be designed with a permanently installed lifting handle & a lifting system which allows the pump to be retrieved from the exterior of the wet well (*ie. there shall be no need for personnel to enter the wet-well for pump removal*).
- 6) The pump(s) shall automatically and firmly connect to the discharge connection elbow, guided into place by two guide bars extending from the top of the station to the discharge connection elbow. Sealing of the pump discharge face to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A guide bracket for sliding down the guide bars shall be an integral part of the pump unit.
- 7) Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface by means of a diaphragm, O-ring or other devices will not be acceptable.
- 8) The pump shall be completely supported by the discharge head. No portion of the pump shall bear directly on the wet well or sump floor.
- 9) All mating surfaces between individual pump components shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit. Rectangular cross sectioned gaskets

requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

- 10) All exposed nuts or bolts shall be 304 stainless steel construction.

d. Cooling System

- 1) Motors shall be designed to be sufficiently cooled by the surrounding environment or pump media. A water jacket shall not be required.

e. Power Cable Entry Seal

- 1) The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single or double cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable.
- 2) The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

f. Pump Power Cable

- 1) The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the pump disconnect panel or junction box without the need of any splices. The power & control cables shall be designed specifically for use with submersible pumps and shall be type SUBCAB (*SUBmersible CABLE*).
- 2) In addition to being SUBCAB rated, pump power cables shall be Flygt Optional Shielded Power Cables, designed for use with VFDs and to avoid interference between parallel power & instrument cables in the cable tray or inside the wetwell.
 - a) The cable shall be multi-conductor type (*suitable & rated for use with full voltage starters, soft starters and VFDs*) with stainless steel braided shielding, tinned copper control wire conductors insulated with ethylene-propylene rubber, and a chlorinated polyethylene rubber outer jacket.
 - b) The sensor conductors shall be arranged in twisted shielded pairs.
 - c) The power cable shall be rated for 600 Volts and 90°C (194°F) with a 40°C (104°F) ambient temperature and shall be approved by Factory Mutual (FM).
- 3) The motor and cable shall be capable of continuous submergence underwater

without loss of watertight integrity to a depth of 65 feet.

- 4) Cable supports (*basket cable grips*) shall be provided on each pump power cable and shall be stainless steel wire braid sleeves with attachment tails for connection to the disconnect stand and to the access hatch frame (*minimum of 2 basket cable grips per pump power cable*).
- 5) Each pump power cable shall be provided with a Meltrics disconnect rated plug to match the Meltrics receptacle on the Pump Disconnect Panel.

g. Stainless Steel Cable Basket Grips.

- 1) Each pump power cable (*and each pump signal cable where applicable*) shall be provided with a minimum of two stainless steel basket cable grips designed to support the weight of the respective cables.

h. Motor

- 1) Premium Efficiency Motor. Unless otherwise specified or specifically noted on the drawings, all pump motors shall be premium efficiency (PE) rated.
- 2) The motor and pump shall be designed and assembled by the same manufacturer. Unless otherwise specified or shown on the drawings, all motors shall be wired for 3 phase 460 volt power as required.

For retrofit applications, the Contractor shall field confirm motor voltages prior to having the pump supplier prepare submittals or place orders. Motor and pump assembly shall be rated for Class I Div 1 hazardous locations per the NEC.

- 3) The pump motor shall be an induction type with squirrel cage rotor, shell type design, housed in an air filled, watertight NEMA B type chamber, and shall be manufactured by the pump manufacturer.
- 4) The stator winding and stator leads shall be insulated with moisture resistant Class H insulation that will resist a temperature of 180°C (356°F). The stator shall be insulated by trickle impregnation method using Class H monomer-free polyester resin, resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable.
- 5) The motor shall be designed for continuous duty handling pumped media up to 40°C (104°F) and capable of sustaining a minimum of fifteen (15) evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum.
- 6) Thermal switches shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel.

- 7) The junction chamber containing the terminal board, shall be hermetically sealed from the motor by an elastomer O-ring seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. Wire nuts or crimping type connection devices are not acceptable.
- 8) Motors shall have a service factor rating of not less than 1.15. Motors shall be of sufficient horsepower to operate the pumps without overloading throughout the entire operating range of the pump without use of the service factor (*ie. from shut-off through run-out*).
- 9) The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C.
- 10) Motor Protection
 - a) Thermal switches set to open at 125°C (260°F) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The thermal switches shall be set to stop the motor and activate an alarm.
 - b) A Float Leakage Sensor (FLS) shall be provided to detect water in the stator chamber. When activated, the FLS shall shut down the leaking pump motor and will send an alarm signal both local and/or remote. The use of voltage sensitive solid state sensors shall not be allowed.
 - c) The thermal switches and FLS shall be connected to a Mini-CAS (*Control and Status*) monitoring unit. The Mini CAS shall be designed to be mounted in any control panel, with the control panel and reset buttons wired per the manufacturer's recommendations. The Mini-CAS shall be furnished by the pump supplier to the Owner's Integrator of Record (The Automation Group) for installation in the pump control panel by furnished by the Owner.
- i. Bearing: The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single ball type bearing to handle radial loads. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum L₁₀ bearing life shall be 50,000 hours at any usable portion of the pump curve.
- j. Mechanical Seals
 - 1) Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide ring. The upper secondary seal, located between the seal

chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring.

For 3153 & larger pumps, the rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber.

All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable.

- 2) Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.
 - 3) The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.
 - 4) Seal lubricant shall be FDA Approved, nontoxic.
- k. Pump Shaft: The pump and motor shaft shall be a single unit (*ie. the pump shaft shall be an extension of the motor shaft*). Couplings shall not be acceptable. The shaft shall be AISI type 431 stainless steel. The use of stainless steel shaft sleeves will not be considered equal to stainless steel shafts.
- l. Volute/Suction Cover: The pump volute shall be single piece, gray cast iron, Class 35B, non-concentric design and shall have smooth fluid passages large enough at all points to pass any size solid that can pass through the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring or wear ring as summarized below.
- m. Impeller: The impeller shall be of ASTM A532 (Alloy IIIA) 25% chrome cast iron, dynamically balanced, non-clogging design having a long through-let without acute turns. The impeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. A full vaned, not vortex, impeller shall be used for maximum hydraulic efficiency; thus, reducing operating costs.
- 1) N-type Impeller

- a) The impeller shall be of semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on the volute suction which shall keep them clear of debris, maintaining an unobstructed leading edge.
- b) High chrome impellers shall be provided on all pumps, unless use of standard impellers is specifically required or noted on the drawings.
- c) On standard impellers, the impeller vanes shall be hardened to Rc 45. High chrome impellers shall be Rc 60. Impellers shall have screw-shaped leading edges and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in waste water. The screw shape of the impeller inlet shall provide an inducing effect for the handling of sludge and rag-laden wastewater.
- d) The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impellers shall be locked to the shaft, held by an impeller bolt.
- e) Volute Bottom/Insert Ring
 - (1) The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable volute insert ring containing spiral-shaped sharp-edged groove(s). The spiral groove(s) shall provide the relief path and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so as to remain unobstructed.
 - (2) The sharp spiral grooves shall provide the shearing edges across which each impeller vane leading edge shall cross during its rotation in order to remain unobstructed. The clearance between the internal volute bottom and the impeller leading edges shall be adjustable.
 - (3) The insert ring shall be cast of ASTM A532 (Alloy IIIA) 25% chrome cast iron and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

n. Protective Coatings

- 1) All pumps, motors and appurtenances shall be factory coated with a corrosion resistant coating at least equivalent to the following. All metal surfaces, other than stainless steel or brass, coming in contact with the pumped liquid shall be protected by a factory applied acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
- 2) All damage to exterior protective coating occurring during shipment or

installation shall be repaired in the field using the same coating system as used in the factory.

2.5 PUMP DISCONNECT PANEL STAND (AIR-GAP STAND)

- a. A lockable pump disconnect panel air gap stand shall be provided below the pump disconnect panel (PDP) which is mounted at the wetwell or other location as shown on the drawings. The disconnect panel air gap stand shall be constructed of 304 stainless steel.
- b. The DPP air gap stand shall be the same width and depth as the disconnect panel. The bottom of the disconnect panel shall be mounted a minimum of 48 inches above the wetwell top slab (*or above the finish grade if mounted elsewhere*). The PDP stand shall extend from finish grade at the stand location to the bottom of the disconnect panel. The entire front panel of the DPP stand shall be a lockable, hinged door capable of opening 180 degrees, and shall not result in any gaps when the door is closed. The door shall include a padlock hasp sized for the City's standard padlock hasp (*Contractor responsible to verify size*).
- c. The PDP stand frame shall be constructed using stainless steel tube, angle, or bars per the details on the drawings. The PDP stand sides and the PDP stand door shall be enclosed with stainless steel expanded mesh or perforated sheets.
- d. Anchor Bolts. The disconnect panel stand shall be fastened to the wetwell top slab with stainless steel anchor bolts (*expansion wedge anchors or epoxy set anchor bolts*) with 5" minimum embed.

PART 3: EXECUTION

3.1 GENERAL

- a. All mechanical portions of the installation shall comply with drawing details, the requirements outlined below, the manufacturer's latest recommendations and the best practices of the industry.
- b. **FACTORY PUMP TESTS REQUIRED PRIOR TO SHIPPING:** Prior to shipment, all pumps, control panels and panel assemblies shall be tested for proper operation at the manufacturer's factory.

3.2 PUMP & ACCESSORY INSTALLATION

- a. Carefully handle and protect the pump and appurtenances. Pumps and appurtenances shall be supported on blocks during storage and delivery to prevent damage.
- b. Pump assemblies shall be installed such that the pumps, discharge piping and guide rails are properly aligned, plumb and level, unless otherwise specifically shown or noted on the drawings.
- c. Install internal piping, discharge piping, upper guide bar brackets, and intermediate guide bar

brackets as shown or required.

- d. Height to First Intermediate Guide Bar Bracket. Unless otherwise specifically shown on the drawings, the first intermediate guide bar bracket shall be set 20 feet above the pump discharge head (*in order to minimize the risk of debris buildup on the bracket in the event of a wetwell surcharge event*).
- e. Following installation of the discharge connection elbow, guide bar bracket(s), and guide bars, check the guide bars and the discharge piping for plumbness in both planes and adjust as necessary.
- f. Seal Pump Cable End to Prevent Moisture Intrusion. Prior to installation of pumps, the Contractor shall verify that the upper end of the pump cable has been sealed with a high quality protective covering to make it impervious to moisture or water seepage prior to final electrical connections, etc.
- g. Lower pump units into place along guide rail system. Visually check the metal-to-metal contact between the volute flange and the discharge connection elbow.
- h. After the pumps have been set in position, and all components aligned and anchored, grout the discharge pipe penetrations and other wetwell penetrations with non-shrink grout.

Provide protective coverings over the FRP wetwell insert during grouting work to prevent grout spillage onto the FRP surfaces.

- i. Install the pump so that connection may be made to the discharge header without springing or otherwise forcing either the pump or the header. All strain from attached piping shall be eliminated from the pumps. Any evidence of pump mis-alignment, noisy operation, leakage or other signs of improper setting shall be corrected by the Contractor.
- j. Coat all bolt threads with lubricant to facilitate future removal.

3.3 LEVEL SENSOR INSTALLATION

- a. Level probes and transducers shall be mounted on cable hangers attached to manufacturer provided mounting brackets at levels shown on the drawings or directed by the Owner's Representative, and the Contractor shall demonstrate proper operation.
- b. Level probes and transducers shall be mounted on probe brackets with an integral cleaning squeegee, and cables shall be secured around the perimeter of the wetwell hatch as required to avoid interference with installation or removal of the pumps (*ie. cables shall not cross over or hang behind the pump guide rails*). Provide stainless steel hardware as required to anchor the probe bracket and support the cables to accomplish this.
- c. Excess Cable. Provide all probes (*including the overflow sensor probe*) with excess cable to allow the probes to be lowered to the bottom of the wetwell as required to test the probe operation by manually lowering each to the water level. Excess cable shall be secured as specified below.

3.4 PUMP POWER CABLE & LEVEL SENSOR CABLE MANAGEMENT

- a. Excess cable shall be neatly coiled and hung in the wetwell in a manner so as not to interfere with pump removal or access to the pump removal lifting chain sling.
- b. Excess cable coils shall be secured with plastic cable ties, and hung as high in the wetwell as feasible, out of the way of pump removal operations. Cable coils shall be mounted to the hatch nut-rail or the inside of the hatch skirt (*cables shall not be hung from the hatch doors or the hatch safety grates*).
- c. Excess cable shall NOT be stored or coiled inside the disconnect panel air-gap stand.

3.5 INITIAL LUBRICATION

- a. Initial lubrication required for start-up and field test operation shall be furnished and applied in accordance with the manufacturer's recommendations.

3.6 FORCE MAIN FILL PRIOR TO STARTUP AND TESTING

- a. Unless otherwise approved in writing by the Owner's Representative and the pump manufacturer, the force main shall be filled with non-sewage fresh water prior to pump startup and testing. Contractor shall be responsible for obtaining sufficient water to fill the force main as summarized below.
- b. Force main filling is typically required to ensure that the pumps operate under design discharge & head conditions, and to prevent pump cavitation or possible pump/motor damage due to operation outside of the recommended design portion of the pump discharge curve.

The force main shall be filled by pumping clean water through the bypass pump port connection (*prior to initial startup of the sewage pumps*), if such a port is provided.

- c. Any approval by the Owner's Representative to fill the force main with the sewage pumps will be based on a written documentation and certification by the pump supplier that filling the force main with the sewage pumps will not result in cavitation conditions, and will not result in the pump operating outside of the recommended design portion of the pump discharge curve or exceeding the amperage limits of the motor (*without utilizing the motor service factor*).
- d. Where VFDs are utilized, it may be acceptable to program the VFDs to limit the pump speed in a manner to control the pump discharge and head conditions (*and motor amperage draw*), in order to avoid risk of such damage.

If proposed by the Contractor and approved by the Owner's Representative, the Contractor and/or pump supplier shall be fully responsible for any such VFD programming required for filling the force main with the sewage pumps.

3.7 CONTROL SYSTEM CONFIGURATION & PROGRAMMING.

- a. Final configuration, connection & operation of control systems and alarm systems shall be coordinated by the Contractor, and shall be acceptable to the Owner.

- b. Contractor shall coordinate and provide all support necessary during the programming of all control systems by the City as specified, as well as for the programming by the City of the telemetry, alarm and SCADA system.

The City reserves the right to require modifications to the electrical, control or telemetry system wiring if they do not meet the City's operational requirements or communicate with other systems or components as specified.

3.8 INSPECTION, INSTALLATION, START-UP AND TESTING OF PUMPS

- a. The Contractor shall furnish a representative of the manufacturer to perform inspection, start-up and training services. The manufacturer's representative shall be experienced in the inspection, operation, testing and maintenance of the equipment.
- b. Inspection Prior to Installation, Observation During Installation. The pump manufacturer's representative shall full inspect the pumps, cables and associated appurtenances prior to installation of the pumps in the wetwell. The representative shall inspect the pump power and control cables of all pumps for damage or flaws prior to initial installation into to the wetwell.
- c. Observation During Pump Installation. The pump manufacturer's representative shall either perform the initial installation of the pumps into the wetwell, or observe the initial installation of the pumps into the wetwell if performed by the Contractor or others, and perform initial testing and start-up of the pumps and all associated equipment.

This initial inspection and installation service shall be provided for a minimum period of one trip and one day for each pump installation location.

- d. After the pumps have been installed and connected, the contractor shall coordinate with the pump manufacturer representative to complete the following as a minimum:
 - 1) Meg the stator and power cables.
 - 2) Check seal lubrication.
 - 3) Check power supply voltage.
 - 4) Check for proper rotation.
- e. The pump manufacturer representative shall certify that the pumps installation was performed correctly and that the equipment was satisfactorily tested for rotation, operation, etc. In conjunction with the startup and operational testing of the pumps, the contractor shall coordinate with the pump manufacturer representative to complete the following:
 - 1) Meg the stator and power cables (*after pumps are submerged*).
 - 2) Measure motor amperage under operating conditions and no load current.
 - 3) Check level control operation and sequence.
 - 4) Complete all inspection, startup, testing and training summarized below, including collecting all information required for the startup form attached under Part 4.

3.9 SUB-SYSTEM TESTING, FOLLOWED BY COMPLETE PUMP STATION INSPECTION, START-UP, TESTING & TRAINING

- a. Startup/Testing of Sub-Systems **Required** Prior to Scheduling Complete System Startup.
 - 1) **AFTER** the Contractor and the applicable supplier has completed the initial start-up

and testing of each sub-system and verified that all components and systems are operating correctly and as specified (*ie. separate pre-testing of each sub-system*), the Contractor shall schedule a witness test of the complete system by the Owner's representatives and agency staff, at a time acceptable to the Owner, with a minimum of 72 hours (*three business days minimum*) notice provided to allow all parties to be scheduled.

- 2) Startup and testing of the full complete system shall not be scheduled until **AFTER** the startup and testing and certification (*by each respective manufacturer's representative*) of all equipment, control systems, flow meter system, auxiliary power generator & ATS, telemetry and communications systems, and **AFTER** all control system and telemetry system programming is completed and installed (*whether such programming is by the contractor or by the Owner*).

b. Operational Acceptance Tests (Pump Control System). The following is a general summary only, and does not supersede or replace inspection, startup, testing or training requirements contained on the electrical/control drawings or in the instrument/electrical/control specifications (Division 13 & Division 16).

- 1) The objective of these tests is to demonstrate that the Pump Control System has been properly installed, calibrated and wired, and is fully programmed and ready for startup and test operation of the complete system.

For specific requirements, procedures, forms, etc., see requirements under Division 13 & 16 as applicable.

- 2) The Pump Control System shall be checked for proper installation, adjusted, and calibrated on an element-by-element basis to verify that it is ready to function as specified.
- 3) All system elements shall be checked to verify that they have been installed properly and that all terminations have been made correctly.
- 4) All discrete elements and systems, shall be programmed and have their set points adjusted, and shall be checked for proper operation (*ie. interlock function, contact closure on rising/falling level, etc.*).

c. Coordination of Startup and Test Operation of **COMPLETE** System.

- 1) After completion of all sub-system startup and testing as noted above, the general contractor shall be responsible for the coordination with all trades, subcontractors and/or suppliers as necessary for the testing and test operation of all equipment, electrical and control systems to demonstrate that the total system operates as specified and shown on the drawings, and that all system components operate correctly and communicate with all other system components as necessary for a complete and operable system.
- 2) Attendees Required to be Present. Full system startup and witness testing shall be performed with the Owners Representative and the Owner or Agency's operators present. As a minimum, the startup & test operation shall include a representative

of the design engineer of record, electrical engineer of record, general contractor, pump station subcontractor (*if different from the general contractor*), electrical/controls subcontractor(s), pump supplier, control system supplier, telemetry system supplier, flow meter supplier, and agency operations staff.

- a) The representative for the pump control supplier shall be on site during all full system start-up and testing activities, including but not limited to the Owner's telemetry system start up and commissioning.
 - b) The presence of a representative of the auxiliary power system supplier is optional, as long as the electrical contractor is trained and able to operate the auxiliary power system in order to simulate power failures, to verify communication of alarms & faults, etc.
- 3) The contractor's personnel and/or suppliers shall operate or arrange for the operation of all systems and equipment under normal and alarm conditions and simulate all operating modes of all of the equipment, including all alarm conditions, and verify proper alarm notification via telemetry or autodialer as applicable.
 - 4) If there are incomplete or inoperable systems discovered during the startup, the Contractor shall schedule and provide a follow up system startup by qualified personnel after the deficiencies are corrected. The Owner's witness of start-up and testing shall be after all deficiencies have been corrected. Any and all trips by the respective trades, subcontractors and/or suppliers as required to accomplish this (*and associated costs*) shall be the sole responsibility of the Contractor.

d. Start-Up and Testing of Complete System.

- 1) The Contractor shall furnish a representative of each equipment manufacturer to perform inspection, start-up and training services on each equipment system. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment.
- 2) The representative shall check the installation and supervise initial start-up of the equipment. He shall certify that the installation is correct and that the equipment has operated satisfactorily. This service shall be provided for a minimum period of two trips on two days for each equipment system. If additional trips and days are required to adequately test, program or troubleshoot the equipment or systems, this shall be provided at no cost to the Owner.
- 3) Clean Fresh Water Testing Required. Contractor shall be responsible for obtaining sufficient water (*non-sewage, fresh water*) to fill the wetwell and force main and to conduct the required clean water wetwell and pumping tests, including providing all hoses, pumps or other accessories required. If adequate water cannot be obtained from hydrants or watercourses in the vicinity of the pump station, the Contractor shall provide water trucks or other means of transporting required water. Owner will furnish electrical power for pump field performance tests.
- 4) Overflow Sensor Verification Testing. Contractor shall be responsible to fill the

wetwell (and any sewers between the wetwell and the overflow point) to the overflow level (with the Owner's Representative and agency with jurisdiction present) in order to verify that the overflow sensor is set at the correct elevation.

e. Pump Field Performance Test.

- 1) Before installation or startup, impeller, motor rating and electrical connections shall be checked by the pump supplier for compliance with this specification.
- 2) Prior to submergence, each pump shall be run dry to establish correct rotation (*ie. bump test*).
- 3) All pump performance tests shall be conducted on all pumps (*including spare pumps*) prior to introduction of wastewater into the wetwell.
- 4) The Contractor shall be responsible for verifying proper operation of all system components and pre-testing the system prior to scheduling tests to be witnessed by the Owner.
- 5) Prior to acceptance of any pump (*including spare pumps*), the contractor shall demonstrate proper operation of pump against the pump curves, at which time data shall be taken on the total head, flow and amperage requirements of pump. Pump field performance testing will be based upon measurements during deadhead tests and on discharge or drawdown tests (*summarized below*) performed by the Contractor and witnessed by the Owner.
- 6) Contractor shall furnish all instruments, measuring devices, labor and equipment as required for this procedure.
- 7) Pressure gauge verification test. Where separate pressure gauges are provided on each pump discharge line (*on discharge side of check valves*), verify that all gauges read the same while pumps are running and pump isolation valves are open.
 - a) Turn on one or more pumps. The pressure will equalize to all pressure gauges.
 - b) If all pressure gauges do not read the same, determine and correct the source of the discrepancy.
- 8) Individual Pump Deadhead Tests.
 - a) Test pumps at full speed (*use HOA switch in Hand position unless otherwise approved by Owner's Representative*).
 - b) Record both the water level in the wetwell and the pressure in the valve vault during the test (*after pump is up to speed and any mix-flush valve has closed*). Ensure that pumps are operating at full speed.
 - c) Correct the water level and pressure readings to correspond to pump discharge pressure, and compare to the pump curve deadhead pressure.
- 9) Individual Pump Discharge Capacity Tests.
 - a) Test pumps at full speed (*use HOA switch in Hand position unless otherwise approved by Owner's Representative*).
 - b) Unless a discharge flow meter is available to read discharge flow rates

directly, perform a drawdown test for each pump as noted below.

c) Drawdown Test.

- (1) Record the starting water level, stopping water level, pump run time (*seconds*), and discharge pressure (*starting & ending*) during each test cycle.
- (2) Use the water level drawdown and time measurements to determine an average pump discharge rate during the test cycle.
- (3) Use the discharge pressure measurements to determine the average discharge pressure during the test cycle.
- (4) Correct the water level and pressure readings to correspond to pump discharge pressure.
- (5) Use the corrected pump discharge pressure to define the point on the pump curve that the pump was operating at during the drawdown test.

- d) The duration of the drawdown test cycle must be at least equivalent to the volume of a full pump cycle (*5 feet minimum*). To simplify the volume calculations during the drawdown test, both the starting and the stopping water levels should be above any wetwell fillets (*sloped section at the bottom of the wetwell*).

10) Test Failures.

- a) Units failing the field performance test shall be repaired and retested. If pump fails the second test, the unit will be rejected and the Contractor shall furnish a unit that will perform as specified.

f. Training.

- 1) After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the Owner's personnel in the proper operation and maintenance of the equipment, prior to placing the pump station in permanent operation and service.
- 2) This shall be in addition to the startup trip outlined above, and shall include a minimum of two trips on two different days acceptable to the Owner.

3.10 FOLLOWUP INSPECTION/TRAINING

- a. In addition to the initial training, the Owner reserves the right to require additional trip(s) for followup inspection, service and/or training during the warranty period, as follows.
- b. The Contractor shall provide one (1) field inspection (*and coordinate inspection by representatives of major equipment manufacturers*) near the end of the first year of service to inspect the equipment, make any necessary adjustments and coordinate for followup instruction of operating personnel to assure proper performance of the system.
- c. Where a 2 year warranty is provided, the Contractor shall provide another field inspection near the end of the second year of service to inspect the equipment, make or coordinate any necessary adjustments and instruct operating personnel to assure proper performance of the system.

- d. These services shall be scheduled with the Owner, and shall be furnished without cost to the Owner.

PART 4: SPECIAL PROVISIONS

4.1 PUMP SCHEDULE

PUMP SCHEDULE							
Pump No.	Location	Speed RPM	Motor Size HP	Motor Voltage	Capacity GPM @ TDH (ft)		Make & Model
					GPM	TDH.	
1 and 2	Plant Pump Station	VFD 3445 max	6.5	460V	100	87	Flygt NP 3102 SH (256) (Shutoff Head - ±110")
					250	60	
					400	28	
Factory tests shall demonstrate that each pump can provide the specified flowrate <u>at or above</u> the specified duty point head conditions specified, regardless of the HI testing method used.							

SECTION 11751
PUMP STATION WET WELL SYSTEM

PART 1: GENERAL

1.1 SCOPE

- a. This section includes furnishing and installing the Plant Pump Station concrete wetwell structure with precast or cast-in-place base slab, walls/riser section, & top slab assembly (*as noted on the drawings or as specified*), and other appurtenances as specified or required for a complete installation and for satisfactory operation.
- b. All work performed under this section shall be in accordance with all approved trade practices and manufacturers' recommendations, including provisions for insulation between dissimilar metals where applicable.

1.2 RELATED SECTIONS

- a. Section 03200, Concrete Reinforcement
- b. Section 03300, Cast-in-Place Concrete
- c. Section 11750, Submersible Sewage Pumps

1.3 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*), as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) Submittals for Review
 - a) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item), including but not limited to the following.
 - (1) Reinforcing bar and/or reinforcing wire utilized in reinforced precast concrete products or cast-in-place concrete.
 - (2) Lids, frames, hatches, ladders, or other components made from iron or steel.
 - b) Submittals & complete shop drawings including:
 - (1) Complete specifications, descriptive drawings, and literature for all portions of the wet well structure and associated components, including hatches, mounting systems, base sump, wetwell insert, etc.
 - (2) Rebar Shop Drawings. Complete reinforcing (*rebar*) shop

drawings for all rebar to be installed in cast-in-place or pre-cast base slabs and top slabs, including bending lists and placing drawings.

- (a) Rebar shop drawings for top slabs shall also include fully dimensioned locations for hatches (*hatch offsets to be labeled as being measured from hatch frame skirt and/or nutrails*) and other embedded items (*as well as indication showing the opening direction of the hatches for reference during hatch placement and top slab construction*).
- (3) Base Slab. Complete layout drawings & sections for base slab showing (*in addition to reinforcing steel*) all inserts including (*as applicable*) waterstop at base-slab/1st-barrel joint (*including notes referencing the Supplemental Vertical Waterstop Fasteners required per para 2.1.k.1.c*), inserts as applicable, etc.
- (4) Top Slab. Complete layout drawings & sections for top slabs showing (*in addition to reinforcing steel*) all inserts including wetwell hatch, wetwell vent, cable tray, jib crane anchor bolts or inserts (*if applicable*), etc.
- (5) Base Slab and/or Top Slab Precast Certification Letter. Certification letter signed by the manufacturer's representative specifically including the following as a minimum:
 - (a) The location & address of the plant where the wetwell barrel sections and any precast base slabs or top slabs will be cast.
 - (b) Confirmation that the precast base slab and/or precast top slab will be formed and poured on a polished concrete surface as specified.
 - (c) Confirmation that the specific molds required for the specified joint style are available at the plant where the barrel sections and/or precast slabs will be cast.
 - (d) Confirmation that the wetwell manufacturer and the Contactor will jointly warrantee the wetwell barrels & base slab against any visible leakage for a period of three (3) years from date of installation.
 - (e) Precast Top Slab and/or Base Slab Inspection Requirement Acknowledgement. Confirmation that the manufacturer has read and understands the requirements in Part 3 of this section related to Inspection of Forms, Reinforcing & Embedments and Precast Top Slab or Base Slab Scheduling, and will comply with these provisions, including inspection notice timeframe requirements.
- (6) Mix designs for each type and class of concrete, including required laboratory testing data, as well as historic compressive strength results for the mix design.
- (7) Fully dimensioned fabrication shop drawings for the wetwell

hatch, safety grate, cable tray & associated components to be installed in the wetwell top slab. The hatch shop drawings shall clearly show & dimension all aspects of the hatch & cable tray, including but not limited to the following, demonstrating full conformance with specification & detail requirements.

- (a) Hatch frame style & hatch skirt depth matching the full top slab thickness.
 - (b) Full perimeter nutrail, including dimension above the bottom of the hatch skirt.
 - (c) Detail showing gap in hatch frame at cable tray (*ie. hatch frame to be cut out the full width of the cable tray bottom channel*).
 - (d) Detail showing cable tray is configured to extend to the edge of the hatch door without a gap (*with hold-down tabs on each side of the cable tray designed to keep the end tabs of the cable tray top cover locked down on the hatch end as required, independent of the hatch doors*).
 - (e) Notes that the aluminum end plate shipping brace (*on the disconnect panel end of the cable tray*) is to be cut out after the cable tray is cast into the top slab, with side portions left to act as end stops for the cable tray cover (*ie. at the disconnect panel end*).
- (8) Copy of OSHA certification and proposed warranty for access hatch.
- (9) Fully dimensioned fabrication shop drawings for the influent deflector plate, wetwell vent, and other shop fabricated components to be installed in or on the wetwell structure.
- (a) Influent deflector plate shop drawings shall show the wetwell wall (*radiused or flat wall as applicable*), and the submittal shall include standoff dimension from the wall to the plate (*as measured at the center of the plate*), as well as the dimension from bottom of the plate to the wetwell fillet (*as measured at the center of the plate*).
- (10) FRP wetwell sump insert, including installation instructions & procedures conforming with requirements herein.
- (a) Complete dimensional information showing the diameter and depth of the insert, thickness of walls & dividers, floor thickness, etc.
 - (b) Dimensioned locations illustrating where the anchor bolts for the pump discharge bases will be installed (*see anchor bolt requirements in section 11750*).
 - (c) Dimensioned locations of all grout entry & air release holes in any areas where grout cannot freely flow around the exterior of the FRP insert, to ensure that grout can fully penetrate to into any enclosed areas (*ie. between the shell and any sloped FRP plates*) and avoid any void spaces when the FRP insert is grouted in place.

- (11) Bidco External Joint Wrap by Telleborg, or equal (*to be installed on the external surfaces of any below grade construction joints in the cast-in-place wetwell, and on the external surfaces of all barrel joints and penetrations as applicable*).
 - (a) Written confirmation that plastic stretch wrap (*ie. pallet wrap plastic*) will be used to cover external mastic wrap on joints and pickholes as specified (*ie. protection from displacement during backfill installation & compaction*).
 - (12) Sheeting/shoring/dewatering plan for deep excavations, to demonstrate conformance with the specification requirements and/or recommendations of the geotechnical report as applicable. Provide information on all equipment & systems proposed for use, as well as how any temporary wells will be abandoned per State standards after completion of excavation & backfill. Provide information on monitoring wells to verify water levels outside of the excavation limits as applicable.
- 2) O&M Manuals - Operations and Maintenance information, including parts lists and complete manufacturer's literature for each piece of equipment, shall be submitted for all materials and equipment furnished under this and related sections.

1.4 WARRANTY

- a. Wetwell Structure, 3 Year No Leakage Warranty. The wetwell manufacturer and the Contactor shall jointly warrantee against defects in material and workmanship and against any visible leakage in the wetwell barrel or base slab for a period of three (3) years from date of installation. Any visible leakage within the warranty period shall be repaired by injection grouting (*or equal procedure acceptable to the Owner*) at no additional cost to the Owner, including any required bypass pumping to accomplish the repair work.
- b. Access Hatch. The hatch manufacturer shall guarantee proper operation and against defects in material and workmanship for a period of ten (10) years from date of shipment.
- c. Wetwell FRP Base Insert System. The wetwell FRP base insert manufacturer shall guarantee proper operation and against defects in material and workmanship for a period of 10 years from date of installation.
- d. The provisions of these warranties shall not be construed as relieving or reducing the obligations of the Contractor outlined under any other section of these specifications.

1.5 WETWELL INSERT VERIFICATION/CERTIFICATION

- a. The Contractor shall furnish the service of a qualified representative to supervise the installation of the FRP insert. A qualified manufacturer's representative shall be one who has had experience in the installation of the types of insert system specified for this project.
- b. At the completion of the lining system, the following certifications shall be submitted as a minimum and included in the front of the O&M manuals.
 - 1) Certification letter signed by the manufacturer's representative stating the following

as a minimum:

- a) The installation of the insert is as specified and is acceptable to the manufacturer.
 - b) The warranty and/or guarantee will be in full effect during the warranty period with no qualifications or reservations.
- 2) Certification letter signed by the contractor installing the insert stating the following as a minimum:
- a) The installation instructions for the insert installation were received with the wetwell structure.
 - b) The installer has read the manufacturer's recommended installation procedures.
 - c) The wetwell insert was installed in strict conformance with the specification requirements and the manufacturer's recommended installation procedures. Any variances shall be noted.

PART 2: PRODUCTS

2.1 WETWELL STRUCTURE

- a. Mastic Wrap, External Surfaces of All Joints and/or Pickholes on Wetwell Structure. Minimum 9-inch wide external mastic wrap joint seal shall be installed on all below grade joints on the wetwell structure, as well as at any pickholes or other penetrations, prior to backfilling (*Bidco External Joint Wrap BW-9T by Telleborg, or equal*), including the joint between the base slab and barrel sections.
 - 1) See requirements under Section 3 for use of plastic stretch wrap (*ie. pallet wrap plastic*) to hold the mastic tape on joints in place during backfilling.
- b. Precast wetwell components shall be designed to resist all soil and hydraulic pressures, including both lateral pressure and hydraulic uplift. Precast wetwell base slabs, top slabs and barrel sections rings shall conform to the requirements of ASTM C478 except as modified herein.
 - 1) All precast concrete shall be a minimum of 4000 psi at 28 days.
 - 2) All bar reinforcing shall be grade 60 deformed bars conforming to ASTM A-615 or ASTM-616.
 - 3) **Welding on the specified reinforcing in base slabs and top slabs is prohibited.** Bars in addition to those shown that may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at no additional cost to the Owner.
- c. Cast-in Place concrete wetwell base slabs, top slabs and/or walls/riser sections shall conform to the requirements of Sections 03200 & 03300, except as modified herein.
 - 1) At his option, the Contractor may choose to utilize a higher strength mix design for the base slab to allow the wetwell walls or barrels to be placed or stacked earlier (*ie. to allow the base slab concrete to reach design strength more*

quickly). See backfill & stacking time limits in Part 3 of this Section.

- d. All pre-cast concrete shall be a minimum of 4000 psi at 28 days, unless higher strength is shown on the drawings or specified.
- e. Support of Rebar & Inserts. All bars shall be supported by concrete or plastic supports, chairs, spacers, or plastic covered metal hangers specifically designed to support reinforcing, or supported by falsework from above.
 - 1) Driving rebar or stakes into the ground for support inside the forms shall be specifically prohibited.
- f. Chamfers. Unless otherwise specifically noted on the drawings or directed in writing otherwise by the Owner's Representative, above grade portions of concrete members and concrete slabs shall be provided with 3/4-inch chamfers on all exposed corners.
- g. Wetwell Barrel Sections
 - 1) Precast wetwell barrel sections and adjusting rings shall conform to the requirements of ASTM C478 except as modified herein.
 - 2) All joints between wetwell sections shall be O-ring or rubber gasket type conforming to ASTM C-443, unless otherwise approved in writing by the Owner's Representative.
 - a) If the use of barrel joints other than O-ring or rubber gasket (*ie. mastic joints*) are approved by the Owner's Representative and the agency with jurisdiction, the Contractor will be required to provide an extended warranty on the wetwell barrel joints (*ie. supplemental warranty for 1 year longer than the standard 3 year no leakage warranty period required, with the extended warranty to cover the full value of the work required to seal the wetwell structure, including any required bypass pumping*).
 - 3) 12-inch wide external mastic wrap joint seal shall be installed on all manhole barrel joints and over all pickholes after assembly and prior to backfilling (*Bidco External Joint Wrap by Telleborg, or equal*). Notify Owner's Representative for inspection prior to backfilling.
 - a) See requirements under Section 3 for use of plastic stretch wrap (*ie. pallet wrap plastic*) to hold the mastic tape on joints in place during backfilling.
 - 4) Wetwell Barrel Pipe Penetration Core Drilling.
 - a) All wetwell pipe penetrations shall be **core drilled in the field**, after installation of the wetwell barrel sections and verification of inverts as noted below.
 - b) The Contractor shall be responsible for verifying the wetwell base and top elevations prior to core drilling, as well as potholing existing pipelines (*if any*) to which influent or discharge piping will be connected

or cross, which could affect the new pipe inverts. Report any discrepancies to Owner's Representative to allow resolution prior to core drilling.

- c) All pipe penetrations shall be provided with flexible rubber boots to provide a watertight seal. Flexible boots at pipe penetrations shall be "Kor-n-Seal", "Res-Seal", or approved equal.
- d) Gravity Pipe Penetrations: Core holes for the inlet pipe penetration (*and overflow pipe if provided*) shall be radial to the wetwell center unless otherwise shown on the drawings.
- e) Pump Discharge Pipe Penetrations: The penetrations for the pump discharge piping shall be core drilled axially to the pipe alignment rather than radial to the wet well center.

h. Wetwell Base Slab

- 1) Wetwell base slab may be precast or cast-in-place, at the contractor's option.
 - a) Smooth Hard Surface for Precasting. If base slabs are precast, forms shall be set up on a hard polished casting surface (*precasting on soil, gravel, sand or other non-finished surfaces is prohibited*).
 - b) Where precast riser sections are utilized for the wetwell walls, either cast-in-place and precast base slabs shall be manufactured such that the first riser section is cast into AND integral with the base slab. The bottom of the first precast riser section shall be embedded a minimum of 6-inches into the base slab concrete, or as shown on the drawings, whichever is greater.
 - c) Where precast riser sections are cast into the base slab, one strip of hydrophilic waterstop shall be installed on the underside of the inside lip on the bottom barrel joint which is cast into the base slab (*reinforced hydrophilic waterstop, Cetco RX-101T with CetSeal adhesive, or approved equal*).

Supplemental Vertical Waterstop Fasteners. In addition to the waterstop adhesive, a tapcon screw and washer shall also be installed (*through the waterstop into the barrel concrete*) at 24" maximum spacing, to ensure that the vertical waterstop is not displaced during concrete placement.
 - d) Where cast-in-place riser walls are installed, one strip of hydrophilic waterstop shall be installed in the keyway of all concrete joints (*reinforced hydrophilic waterstop, Cetco RX-101T with CetSeal adhesive*).
- 2) The base slab shall be provided with an extended base as shown on the drawings with an overhang sufficient to counteract worst case hydraulic uplift conditions.
- 3) The thickness of the base slab shall be as shown on the drawings, but in no case

shall the base be less than 12 inches thick. Reinforcing shall be provided as shown on the drawings. The reinforcing for the portion of the base slab inside wetwell barrel sections shall be integral with the reinforcing for the extended base outside the barrel sections.

4) Bottom Sump Insert.

- a) The interior of the finished base section shall include a prefabricated self-cleaning sump installed in the base section and the first riser section. This sump is typically concreted in place in the field, but may be cast into the base section by the pre-caster at the Contractor's option (*upon approval of a detailed protection procedure by the Owner's Representative*). If the self-cleaning sump is cast into the base section by the pre-caster, adequate means to brace the insert and prevent deflection during concrete placement shall be used (*ie. protection against flotation, deflection of the sidewalls, as well as protection against concrete spillage*). Any deflection of the sump sidewalls will be grounds for rejection of the base section assembly.
- b) The prefabricated self-cleaning sump shall consist of a prefabricated FRP (*fiberglass reinforced polymer*) or HDPE basin with sloping walls and floor geometry, to cause the fats and debris to slide down to the bottom of the basin. The sump shall be constructed of minimum 1/4-inch thick FRP, and shall include stiffening ribs and mounting legs designed for ensure the unit remains level during placement of concrete fills behind or under the insert. The sump shall be as designed by the manufacturer of the pumps provided, and shall be designed specifically for use with the pumps.
- c) The FRP insert shall be provided with grout entry & air release holes in any areas where grout cannot freely flow around the exterior of the FRP insert, to ensure that grout can fully penetrate to into any enclosed areas (*ie. between the shell and any sloped FRP plates*) and avoid any void spaces when the FRP insert is grouted in place.
- d) The sump shall be designed for use with an electronic sump flushing control with a programmable "cleaning cycle" that runs the pumps down to the "snore" level to remove solids settled on the sump floor.
- e) The sump insert shall be as manufactured by Xylem Corporation (Flygt), or approved equal.

i. Wetwell Top Slab

- 1) Wetwell top slab may be precast or cast-in-place, at the contractor's option.
 - a) Smooth Hard Surface for Precasting. If top slabs are precast, forms shall be set up on a hard polished casting surface (*precasting on soil, gravel, sand or other non-finished surfaces is prohibited*).
- 2) Top slab and hatches shall be designed to support traffic or non-traffic loads as

indicated on the drawings, but in all cases shall be adequate to support pumps and maintenance personnel. The thickness of the precast top slab shall be as shown on the drawings, but in no case shall be the top slab be less than 12 inches thick. Reinforcing shall be provided as shown on the drawings. The reinforcing for the top slab shall include rebar under the support flanges of the hatches, and as required to interact with anchor bolt inserts for pump hoists. The top slab at the hatch shall be formed such that the concrete supporting the hatch frame extends to the inside face of the frame on all sides.

3) Access Hatch

- a) Hatch arrangement shall be double or triple leaf (*one hatch leaf & one safety grate per pump*), hinged as shown on the drawings. Size and clear opening shall be as shown on the drawings. Unless otherwise specified, all hardware shall be stainless steel.
- b) Primary Hatch. All wetwell hatches are to be configured with a primary opening leaf which, when locked, will prevent the other hatch leaves from opening unless the primary hatch leaf is open.
- c) Each hatch shall be designed to combine covering of the opening, fall through protection per OSHA standard 1910.23 and controlled confine space entry per OSHA standard 1910.146. Material shall be 6061-T6 aluminum for bars, angles and extrusions, and 1/4" diamond plate shall be 5086 aluminum.
- d) Hatch rating (*traffic or non-traffic*) shall be as noted on the drawings. Non-traffic hatches shall be pedestrian rated for 300 PSF loading. Traffic rated hatches shall be AASHTO H-20 load rated (*not subject to high density traffic*). Load calculations shall be submitted, with deflection not to exceed 1/150th of the span.
 - (1) Top Slab Height above Finish Grade. Unless otherwise noted on the drawings, traffic rated hatches and cable trays shall be required if top slab elevation is less than 9-inches above finish grade on all sides (*unless bollards are installed at locations and spacing acceptable to the Owner's Representative in order to preclude the possibility of maintenance vehicles accidentally backing onto the hatches*).
- e) The hatch cover leaf shall be 1/4-inch minimum aluminum diamond pattern plate with reinforcing as required to prevent distortion of the leaf when in any position.
- f) Hatch shall be provided with angle frame of extruded aluminum (*1/4-inch minimum thickness*), with anchor flanges to secure the hatch into the concrete.
- g) Hatch Skirt: The hatch frame shall be provided with a vertical full depth aluminum skirt (*1/4-inch minimum thickness*) which extends the full depth of the wetwell top slab. The aluminum plate shall act as a concrete form,

with the skirt being integral with hatch frame, or welded around the full perimeter to be flush with the inside face of the hatch frame.

- h) The exterior of hatch frame and skirt (*in contact with concrete*) shall be supplied with a 2-mil thickness of bituminous coating. Application procedure shall be in accordance with manufacturer.
- i) Hinges shall be of heavy-duty design. Material shall be stainless steel with a 3/8" grade 316 stainless steel pin. Hinges shall be bolted to the channel frame and diamond plate, with grade 316 stainless steel bolts and ny-lock nuts.
- j) Lift Handles. Hatch covers shall be equipped with a recessed cast aluminum handles. Lift handles must be placed at outer edges of cover. The lift handles shall be flush with the top of the 1/4" diamond plate.
- k) Slamlock. Hatch covers shall be supplied with a grade 316 stainless steel recessed Slamlock, with keyway protected by a threaded stainless steel plug. Plug shall be flush with the top of the 1/4" diamond plate. Slamlock shall be fastened with four grade 316 stainless steel bolts and washers.
- l) Recessed Padlock Clip Box. Hatch covers shall be supplied with a Recessed Padlock Clip (RPC) in a hinged box. RPC box shall be a minimum of 3" x 5", and shall be supplied with its own separate hinged cover for owner access to the owner supplied padlock.
- m) Hold Open Arms. Hatch covers shall be equipped with a stainless steel hold-open arms. Covers shall automatically lock open in the 90-degree position. Hold-open arms shall be fastened to the frame with a 1/2" grade 316 stainless steel bolt.
 - (1) The hatch shall be provided with an aluminum nut-rail or unistrut welded to and flush with the inside face of the hatch skirt on ALL sides to allow for the connection of the upper guide bar brackets and other accessories as shown on the drawings or as may be required during the life of the pump station.
 - (2) Unless otherwise shown on the drawings, the bottom of the nut-rail shall be attached 3-inches above the bottom of the full depth hatch skirt (*ie. nut rail to be 3-inches clear above the bottom of the top slab*), and shall be attached to the hatch skirt with a full length fillet weld, top & bottom.
- n) Hatch Safety Fall Protection
 - (1) Each hatch shall be provided with an integral safety grate that provides fall through protection per OSHA standard 1910.23 and controlled confine space entry per OSHA standard 1910.146. The design must assure that the fall through protection is in place before the doors can be closed, thereby protecting the next operator.

- (2) Grating shall be 6061-T6 aluminum designed to withstand the same live load as specified for the hatch. Deflection shall not exceed 1/150th of the span. The grate shall also be designed to support the specific pumps provided at this pump station. This allows the pumps to be pulled from the pit, the grating closed and the pump set back on the grating for pump wash down directly back into the pit.
 - (3) Safety Grates must be supplied with hinge system, hold open arms and lift assist system as the hatch covers (*see reference above*), and shall be designed to be secured in the closed position with a padlock.
 - (4) Grate openings shall be 5" x 5", which will allow for visual inspection, limited maintenance and float adjustments while the safety grate fall through protection is left in place.
 - (5) Grate shall be coated with OSHA safety orange, Dupont Corlar Satin High Solids Epoxy paint, with a Dupont Corlar High Solids Epoxy Mastic Activator. Before coating of grates, grates must be shot blasted to assure a good bond with the Dupont two part epoxy.
- o) All hatches shall be Flygt hatches with the safety grating option, as manufactured by USF Fabrication, or approved equal.

4) Cable Tray

- a) The cable tray system shall be provided that is integral with the access hatch, and by the same manufacturer. The access hatch frame shall be partitioned and reinforced as required to allow for seamless integration and connection of the cable tray to the hatch frame. Any cable tray system that is not integral with the hatch frame (*which does not connect to the hatch frame*) will NOT be approved as equal.
- b) The cable tray provided with angled "slide plate" for uninhibited cable entry into the wetwell. The cable tray shall be designed and configured to allow the aluminum nut-rail to be continuous below the bottom edge of the slide plate, to allow for connection of upper guide bar brackets and/or other accessories.
- c) The cable tray shall include provisions designed by the manufacturer to allow the hatch and cable tray to be shipped separately (*to minimize risk of damage or bending during shipping*), and then field connected together prior to top slab concrete placement.
- d) Unless otherwise shown on the drawing details, the cable tray shall be 9" wide (*inside clear dimension*) with an internal cable partition, with a minimum depth of 3-inches clear from the bottom of the cable tray cover. Unless the cable tray cover is locked in a closed position by the disconnect stand door, a recessed slamlock and padlock hasp shall be

provided for the cable tray.

- e) The cable tray shall be provided with an aluminum plate or aluminum flat bar across the end opposite from the hatch, to prevent concrete intrusion into the cable tray and to prevent deflection during concrete placement. The plate or bar shall be cut out to cable tray ID width after concrete installation, to allow for cable installation. The side portions of the bar or plate shall be left to provide stops for the cable tray cover.
- f) Non-traffic Loading, Cable Tray. The cable tray shall be provided with an aluminum cover that is locked in place at both ends during normal operation, and cannot be removed without unlocking the access door on the pump disconnect panel. The cover shall be rated for a minimum load of 700 lbs per square foot.

2.2 PUMP DISCONNECT PANEL STAND

- a. A lockable pump disconnect panel stand shall be provided as shown on the drawings. The disconnect panel stand shall be constructed of 304 stainless steel.
- b. The pump disconnect panel shall be connected to the side of the wetwell top slab with 304 stainless steel anchor bolts (*wedge anchors or drilled/epoxy anchors*), 5" minimum embed.
- c. The power/control conduits to the disconnect panel shall be continuous (*PVC-GRC as applicable*) from the underground vertical bend to the bottom of the disconnect panel to meet NEC and NFPA requirements (*ie. for passing through the hazardous atmosphere envelope associated with the pump station wetwell hatch*).

2.3 INFLUENT FLOW DEFLECTOR PLATE ASSEMBLY

- a. The wetwell shall be provided with an influent deflector to protect the pumps from liquid impingement, and to minimize off-gassing and air entrainment into the wetwell pool, configured per the standard details and specifications below.
- b. Deflector Plate Assembly Material. The deflector plate assembly shall be constructed of minimum 10 gauge 304 stainless steel, with a full height mounting flange on each side. All components shall also be 304 stainless steel.
- c. Anchor Bolts. The deflector plate panel shall be anchored to the wetwell wall with 1/2" 304 stainless steel anchors (*wedge anchors or drilled/epoxy anchors*) with 12-inch maximum spacing and 4-inch minimum embed.
- d. Bottom Edge Clearance. The bottom edge of the plate is to extend down to a point where there is the vertical clearance from the sump fillet as specified on the applicable detail, measured vertically at the center of the deflector plate. Unless otherwise noted on the detail or drawing callouts, the vertical clearance at the bottom of the deflector plate shall be 2/3 of the influent pipe diameter, but not less than 8-inches.
- e. Deflector Plate Inspection Port & Guillotine Cover. The deflector plate shall have a full size inspection port (*hole through the panel*) in line with the influent pipe, with a

guillotine cover over the inspection port. During normal operation, the inspection port shall be covered by a guillotine cover panel (*access hole cover*). During high flow conditions, the hydrostatic pressure of the water discharging from the pipe shall press the cover plate against the deflector plate assembly.

- 1) Guillotine Cover Removal. The guillotine cover shall include provisions for being raised, removed and replaced with the cable permanently anchored to the wetwell hatch skirt or the wetwell top slab without the need for maintenance personnel to enter the wetwell.
- 2) Guillotine Cover Configuration. The guillotine panel shall have stainless steel tabs hooked down that support it when it is dropped behind the deflector plate.
 - a) The tabs shall hook down by ± 2 -inches, with clearance between the cover panel and the hook as required to slip over the top of the deflector plate.
 - b) Guide channels (*to hold the guillotine cover in place*) are not specified or required, and shall not be provided.
- 3) Guillotine Panel Cable. The guillotine panel shall be provided with a 3/16 inch stainless steel cable (*type 304*), for lifting the guillotine panel off for inspection or maintenance.
 - a) Lower End of Lifting Cable. Attach the lower end of the cable to the lift tabs or lift stud on the guillotine panel per drawing or detail.
 - b) Upper End of Lifting Cable. The upper end of the cable shall be provided with a swaged loop that is permanently bolted to the inside of the hatch frame or other access opening as shown on the drawings.
 - c) Ferrules Required. Any cable loops on the top or bottom of the lifting cable shall be secured with permanent stainless steel ferrules designed for use with the particular cable used, with the tail end of the cable trimmed as close to the ferrule as practical (*the use of cable clamps is prohibited on the lifting cable, since these will snag debris & rags*).

2.4 ANCHOR BOLTS

- a. Anchor bolts for pump discharge bases shall be as specified in Section 11750.
- b. Unless otherwise specified or noted on the drawings, all anchor bolts for shall be 304 stainless steel.
- c. The diameter, length and any bend dimensions of anchors shall be as shown on the drawings or as recommended by the equipment or machinery manufacturer, whichever is more stringent. Sleeves shall be provided as required or as shown for location adjustment.
- d. Unless otherwise required or shown, use 3/4 inch minimum diameter and other geometry as shown on the drawings. In no case shall anchor bolts be more than 1/8-inch smaller than the anchor bolt holes provided by the manufacturer in the equipment or machinery.
- e. A minimum of two nuts and one washer of the same material as the bolt shall be furnished with each bolt, with both nuts being fully engaged on the anchor bolt threads.

PART 3: EXECUTION

3.1 GENERAL

- a. All portions of the installation shall comply with drawing details, the requirements outlined below, the manufacturer's latest recommendations and the best practices of the industry.
- b. Location of the wetwell shall be as shown on the drawings or directed by the Owner's Representative.
- c. All connections to wetwells shall be watertight. Any visible infiltration of water into wetwells shall be considered unacceptable.

3.2 FORM & REINFORCING INSPECTION SCHEDULING

- a. Cast-in-Place Concrete.
 - 1) No cast-in-place concrete shall be placed without prior inspection of the forms, reinforcing and embedded items (*including the first riser section being set for the wetwell base slab*) and written approval from an authorized representative of the Owner's Representative.
 - 2) The Contractor shall call for inspections at least twenty-four (24) hours in advance, and after inspections shall notify the Owner's Representative at least forty-eight (48) hours in advance (*ie. two business days*) of any scheduled concrete placement.
- b. Pre-Cast Concrete Top Slab or Base Slab Scheduling (*Inspection & Concrete Placement*).
 - 1) Smooth Hard Surface for Precasting. All pre-cast top slabs or base slabs shall be formed and poured on a polished concrete surface, or other similar hard surface that will provide a comparable finish, and which will support (*without deflection*) the required chairs or other devices designed to hold up the rebar or barrel sections. Casting pre-cast concrete top slabs on a soil, gravel or sand foundation is specifically prohibited.
 - 2) Inspection Required Prior to Concrete Placement. No concrete shall be placed for the wetwell top slab or base slab without prior inspection of the forms, reinforcing and embedded items (*including installation of the first barrel section as applicable and verification that the hydrophilic waterstop is installed as specified on the vertical surface of the bottom barrel joint that is cast into the base slab, including verification of the use of tapcon screws & washer at 24" max spacing to ensure that the waterstop is not displaced during concrete placement*) and written approval from an authorized representative of the Owner's Representative.
 - 3) Inspection Scheduling. The Contractor shall call for inspections at least seventy-two (72) hours in advance, and after inspections are complete shall notify the Owner's Representative at least forty-eight (48) hours in advance (*ie. two business days*) of any scheduled concrete placement.

- 4) Timing of Concrete Placement after Inspection. If concrete is not placed immediately after completion of the form, rebar & embedments inspection by the Owner's Representative, the forms and embedments shall be completely protected from rain or moisture until the concrete is placed (*ie. set up under cover, indoors, or equivalent*), to ensure that the hydrophilic waterstop is protected from moisture. Any swelling of the hydrophilic waterstop prior to concrete placement will require that the waterstop be replaced (*see also 03300 para 3.4.c*).
- 5) Precast Location Verification. If the top slab or base slab is manufactured at a location more than 60 miles from Salem, Oregon, the Contractor shall be responsible for reimbursing the Engineer for additional travel time and mileage expenses, unless specifically waived in writing by the Owner.
- 6) First Wetwell Barrel Section to be Set in Place for Inspection. For wetwells with precast barrel sections, the first barrel riser section shall be set in place and fully supported at the time that the base slab form & rebar inspection is scheduled, OR a supplemental inspection shall be scheduled if the barrel section is not set at the time of rebar and form inspection (*subject to the inspection notification limits described herein, prior to concrete placement*), including verification that additional bars are installed around any barrel supports which require the main bars to be cut (*as specified or as shown on the drawings, whichever is more stringent*).
- c. It is the Contractor's responsibility to see that the forms are properly cleaned and oiled, reinforcing steel is securely and properly supported in the correct position, and that all embedment items are correctly installed and correctly oriented before calling for inspections. The Owner's Representative may at his option require the use of placement cards if deemed necessary.
- d. Top Slab, Hatch & Embedment Item Orientation. The Contractor shall remain fully responsibility to ensure that hatches, cable trays and other embedded items are correctly located and correctly oriented prior to placing concrete. Failure by Contractor to ensure that hatches and other embedded items in the top slab fully conform with all drawing and specification requirements will not be grounds for an extension of the contract time or an increase in the contract price.
- e. Spare Vibration Equipment Required On-Site. In addition to the concrete vibrators in actual use while concrete is being placed, the Contractor shall have available (*on-site*) a minimum of one (1) spare concrete vibrator in serviceable condition. No concrete shall be placed until it has been demonstrated that all vibrating equipment, including spares, is in serviceable condition.
- f. Hours for Placing – Cast-in-place concrete shall be placed between the hours of 7 a.m. and 6 p.m., unless permission is given to extend that time. No cast-in-place slab shall be placed after 12:00 noon on any last working day of the week. Precast concrete requiring inspection shall be placed during hours when the Owner's Representative can be present.
- g. Interruption of Pour - Each concrete pour shall be completed in a continuous operation with no interruption in excess of 45 minutes.

- h. Initial Set - No concrete shall be placed after its initial set has occurred, and each lift or section within a common concrete pour sequence shall be placed before the previous concrete has reached its initial set (*for purposes of this requirement, "initial set" is defined as when the concrete has hardened to the point where it can support a person without visible deflection or movement of the concrete*). No re-tempered concrete shall be used under any circumstances (*concrete which has already achieved initial set as defined herein, but which can still be fluidized with a vibrator*).

3.3 EXCAVATION & WETWELL INSTALLATION

- a. Excavation for wetwell construction shall conform to the requirements contained herein, shown on the drawings or specified in other applicable sections.
- 1) All excavation work and spoils piles shall remain within the work limits shown on the design drawings.
 - 2) Sheet piling and/or shoring shall be used where required, where specified or required by the Owner's Representative.
 - 3) All sheeting and/or shoring shall be of the Contractor's design, and shall be in accordance with all Federal, State and Local codes and requirements.
 - a) While the Owner's Representative may review the shoring plan to verify conformance with the specification requirements and/or recommendations of the geotechnical report, the Contractor shall remain entirely responsible for the means & methods involved with the installation and use of any shoring system, including applicability for use under any particular conditions.
- b. Dewatering Plan.
- 1) Wellpoints, sumps or similar methods shall be installed as required to adequately dewater the excavations as required by the Contract Documents or the shoring & dewatering plan provided by the Contractor, and as appropriate for the soil conditions at the site.
 - 2) The Contractor shall at all times during construction provide and maintain ample means and devices (*wellpoints, sumps, etc.*) with which to remove promptly and dispose of properly all water entering the excavations or other parts of the work and shall keep said excavations dry until the permanent facilities to be placed therein (*pipelines, underground structures, pavement, footings, etc.*) are completed (*and backfilled where applicable*).
 - 3) For timing purposes, the dewatering plan shall address the specification sections which control when backfilling of the wetwell excavation and structure can begin (*which by extension dictates how long the dewatering system must remain in place and in operation*).
 - 4) Any discharge from dewatering pumps shall not result in sediment laden water entering the storm system or adjacent water courses.
 - 5) Water Bearing Sands, Sandy Soils, etc.

- a) In water bearing sand or sandy soils (*or other soils susceptible to heaving*), temporary dewatering wells, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation dry as specified and prevent heave or flowing sand/soil in the bottom of the excavation (*ie. as required to lower the groundwater level outside of the excavation to levels required by the shoring design*).
- b) In water bearing sand or sandy soils (*or other soils susceptible to heaving*), the Contractor shall provide a plan that details the means proposed to lower the water table far enough below the excavation bottom (*as the excavation progresses*) to avoid any heaving or flowing of the underlying sand or soils. Common methods include (A) wellpoints or temporary screened dewatering wells installed to lower the local water table in the area of the excavation, or (B) sheet piles extended far enough below the bottom of the excavation to seal off the water from flowing into the excavation and heaving the bottom soils, or (C) a combination of both methods noted above.
 - (1) If sheet piles are used, provide design calculations for review the project geotechnical engineer, including the level to which the groundwater must be lowered to accommodate the design.
 - (2) If wellpoints or temporary dewatering wells are proposed, provide detailed information on the systems proposed (*including casings & screens proposed*) and the drilling contractor who will be installing the systems, and how they will be abandoned per State rules when they are removed. Provide information on monitoring well(s) & water level probe(s) to be installed outside of the excavation limits (*opposite from or between dewatering wells as applicable*) to allow the groundwater level to be continuously monitored with a level transducer & readout (*or approved equal*).
- c) As the excavations progress, the Contractor will need to coordinate with the Owner's Representative and with the project geotechnical engineer to verify that heaving sand or soil conditions do not exist at the base of the wetwell excavation as it progresses.

c. Backfill & Compaction Under & Around Wetwell Structure

- 1) See minimum time limits prior to backfilling around or over wetwell base slabs as summarized below.
- 2) Backfill Material. Except for the foundation stabilization rock noted below, backfill under the base slab and around the wetwell structure and other appurtenances shall be well graded granular baserock material (*3/4"-0 granular baserock unless otherwise specified below or shown on the drawings*).
- 3) Foundation Stabilization Rock.

- a) Unless otherwise shown on the drawings, a minimum of 18" of 4"-0 well graded quarry rock (*acceptable to the Owner's Representative*) shall be installed below the wetwell base slab granular bedding for foundation stabilization.
 - b) If the quarry rock is not well graded, it shall be mixed with ¾"-0 granular baserock prior to placement.
 - c) Reinforcement geotextile fabric shall be placed between the quarry rock and the subgrade soils and lapped fully up the sides of the excavation to the base slab level, and between the quarry rock and the granular backfill under the structures (*quarry rock shall be completely encapsulated with fabric*).
 - d) Geotextile for Foundation Stabilization Rock Encapsulation and Subgrade Separation. Unless heavier fabric is specified or noted on the drawings, reinforcement fabric (*for over-excavation or under embankments*) shall be a geotextile fabric included on the ODOT QPL list for OSSC (ODOT/APWA) 02320-5 table (*for woven or non-woven fabric*), generally conforming to the values listed below. Slit film fabrics are not allowed.
 - (1) Minimum values for woven: grab tensile strength of 200 lb; tear strength of 80 lb, puncture strength of 430 lbs; AOS of 30.
 - (2) Minimum values for non-woven: grab tensile strength of 315 lb; tear strength of 110 lb, puncture strength of 620 lbs; AOS of 30.
- 4) Backfill & Compaction under Base Slab.
- a) Unless greater depths are shown on the drawings, the graded quarry rock shall be topped with a 12-inch minimum thickness of ¾"-0 compacted granular baserock (*minimum thickness as required to allow for compaction testing as noted below*).
 - b) Compaction of the granular baserock under the base slab shall be achieved by mechanical compaction to a minimum of ninety-five percent (95%) of the maximum dry density per AASHTO T-180 (*ASTM D1557/Modified Proctor*) test method.
- 5) Backfill & Compaction around Wetwell Structure.
- a) The wetwell structure excavation shall be backfilled with compacted granular baserock for a minimum of 5 feet around the structure, unless otherwise noted on the drawings.
 - b) The granular baserock shall be mechanically compacted in lifts not to exceed 4 feet.
 - c) Compaction tests shall be taken on the granular backfill as each lift is placed and compacted.

- d) Compaction around the wetwell structure shall be ninety-two percent (92%) of the maximum dry density per AASHTO T-180 (*ASTM D1557/Modified Proctor*) test method.

d. Base Section/Base Slab Installation

- 1) Dewatering. Excavations shall be dewatered prior to placement of baserock or base section or base slab concrete.
- 2) Compaction tests shall be taken on the baserock prior to placement of the base slab section or base slab concrete.
- 3) The base shall be fully and uniformly supported by the compacted baserock at the specified grade and alignment and shall be set such that the base section is level and plumb.
- 4) The use of spacers between riser sections to accommodate an out-of-plumb base section is specifically prohibited.

e. Time Limits & Base Slab Strength Prior to Backfilling or Stacking Riser Sections

- 1) Prior to Backfilling. Unless otherwise approved in writing by the Owner's Representative, the base slab & first riser section/ walls shall not be backfilled until the concrete has reached a minimum of 75% of the specified design strength, but in no case sooner than 3 days after placement of concrete.
- 2) Prior to Stacking or Placing Riser Sections. Other than the first riser section (*which is to be cast into or be integral with the base slab*), the remaining riser sections or walls shall not be installed until after the base slab concrete has reached 90% of its full design strength (*as evidenced by test cylinder breaks*), or a minimum of 7 days (*whichever is longer*), except as noted below.
 - a) At his option, the Contractor may choose to utilize a higher strength mix design for the base slab to allow the wetwell walls or barrels to be placed or stacked earlier (*ie. to allow the base slab concrete to reach design strength more quickly*).

f. Precast Concrete Riser Sections

- 1) All riser sections shall be numbered by the manufacturer and installed in the order in which they are numbered. The shortest length of riser section to be incorporated into the wetwell shall be installed immediately below the top slab.
- 2) Care shall be exercised to ensure that the vertical reference marks on all riser sections are aligned correctly as each piece is installed.
- 3) Riser section joints shall be grouted smooth inside and out, and lifting holes filled with non-metallic non-shrink grout.
- 4) Pipe connections shall be let into precast concrete walls smoothly. All connections shall be grouted back solid around the entire connection.

g. Self Cleaning Bottom Sump (FRP or Concrete as specified or shown)

- 1) Concrete for sumps, fills behind inserts & fillets shall be cast-in-place concrete as specified. All fillet concrete shall be placed monolithically around the full perimeter of the wetwell, as well as being placed monolithically with fill concrete installed behind FRP inserts *(where such inserts are specified or provided)*.
- 2) The entire vertical surface behind concrete fills & fillets at the bottom of the wetwell *(ie. the inside wetwell wall behind the concrete)* shall be profile roughened with a bushing hammer and cleaned prior to concrete placement, to ensure adequate bond *(and to minimize risk of water intrusion or future displacement of the fillets/fill concrete)*.
 - a) If the Contractor proposes to skip profile roughening of precast wetwell walls, additional #4 dowels *(horizontal)* shall be epoxy set 4" into the wetwell walls *(with 6" length exposed into the concrete fill or fillet, unless lesser lengths are required due to clearance issues)*, spaced at 36" maximum spacing around the perimeter of the wetwell wall, set low enough to allow for the exposed length without interfering with the FRP insert, and to ensure that there is a minimum of 3" cover over all rebar.
 - b) The Contractor shall install a strip of hydrophilic waterstop *(Cetco RX-101 with CetSeal adhesive)* under any concrete fills or fillets inside the wetwell.

The hydrophilic waterstop shall be installed at the joint between base slab & the vertical wetwell walls *(around the entire perimeter of the wetwell at the base of the barrel walls under the fillets/fills)*.

The waterstop around the perimeter of the wall/floor joint shall be protected from all moisture between when it is installed and when the concrete is placed *(waterstop prematurely exposed to moisture shall be replaced prior to concrete placement at no additional cost to the Owner)*.

3) FRP Sump Anchoring & Sand Fill.

- a) Sump Anchor Brackets. The FRP sump insert shall be anchored in place accordance with manufacturer's recommendations prior to concrete fill placement by one of the following methods.
 - (1) Unless a lesser number is certified in writing by the sump supplier as adequate to anchor the sump, install a minimum of 8 clip brackets around the perimeter, anchored into the wetwell base slab concrete and/or barrel concrete with expansion or epoxy anchor bolts, or
 - (2) For sumps with the pumps mounted on the flat bottom of the FRP insert *(and where approved in writing by the sump supplier)*, install all of the epoxy set pump base anchor bolts through the FRP insert into the concrete base slab, and install

temporary plate washers and nuts to anchor the sump in place.

- b) Cover Anchor Bolt Holes. If anchor bolt holes are predrilled all the way through the FRP insert base/floor, and if the pump anchor bolts are not installed prior to concrete fill placement, contractor install tape on the outside bottom of the FRP insert (*over each anchor bolt hole*) prior to placing it in the wetwell, in order to prevent concrete past from intruding into the anchor bolt holes when the area around the FRP sump is filled with concrete.
- c) Sump Sand Fill. In addition to anchoring, the Contractor shall also install 12-inches of painters tape around the top inside finished edge of the FRP insert, and then fill the FRP sump insert with moist sand prior to placement of cast-in-place concrete behind the insert and the fillets, as protection against flotation of the sump or deflection of the sidewalls, as well as for protection against concrete spillage.
- d) Failure by the Contractor to fill the FRP sump with sand as specified shall result in the Contractor being fully responsible for any deflection, movement or flotation during concrete installation. The Contractor shall be fully responsible to remove and replace the FRP sump and the wetwell base as required to correct the problem.
- e) If the FRP sump is not completely filled with sand as specified and there is concrete spillage which damages or roughens the FRP gelcoat surface when the concrete paste is removed, the Contractor shall be fully responsible to repair the FRP gelcoat as required to provide a factory smooth surface. Either of the situations noted herein shall be completed at no addition cost to the Owner and with no adjustment to the Contract Time.

h. Precast Top Slab

- 1) If the wetwell top slab is precast, it shall not be placed until after the wetwell riser sections have been placed and backfilled with granular material to within 5 feet of final grade. The wetwell shall be checked for plumbness prior to placing the top slab.
- 2) Care shall be exercised to ensure that the vertical reference marks on the top slab are aligned correctly with the riser slab. The contractor shall also verify that the hatch and upper guidebar brackets are properly aligned with the pump discharge heads in the base section.

3.4 INSTALLATION OF EXTERNAL MASTIC WRAP ON MANHOLE JOINTS & PICKHOLES

- a. Mastic wrap on the exterior of below grade wetwell construction joints, barrel joints & penetrations is required for all wetwells, and shall be installed after joint assembly and prior to backfilling.
- b. Clean Wetwell Exterior Prior to Mastic Wrap Installation. The exterior of the wetwell adjacent to each joint shall be clean (*under the mastic wrap*) to ensure a good seal. A wire brush shall be used to clean the exterior surface under the mastic wrap as required to

remove all dirt, loose particles or deleterious material.

- c. Plastic Pallet Wrap for Use Over Joint Wrap Mastic.
- 1) The mastic wrap over wetwell joints shall be held in place with plastic stretch wrap (*ie. pallet wrap plastic*) to hold the mastic tape in place during backfilling (*ie. to protect the external mastic wrap from displacement during backfill installation &/or compaction*). Plastic wrap shall be installed immediately after the mastic wrap is placed.
 - 2) Penetrations. In all cases, pallet wrap plastic shall be used on the mastic wrap covering the exterior of penetrations that are grouted closed.
 - 3) Cold or Wet Conditions. If conditions are cold, wet or otherwise not optimum for complete adhesion of the mastic wrap to the wetwell wall (*as determined by the Owner's Representative*), the mastic shall be warm and pliable prior to installation.

3.5 WETWELL LEAKAGE TESTING, ETC.

- a. Wetwells that exhibit any visible water infiltration or leakage **OR** which do not pass leakage testing summarized below shall be repaired by the contractor in a manner acceptable to the Owner's Representative, at no additional cost to the Owner.
- b. Following completion of all pipe penetrations in the wetwell, the Contractor shall conduct hydrostatic leakage testing as outlined below unless otherwise approved in writing by the Owner's Representative:
- 1) The test shall consist of plugging all inlets and outlets and filling the wetwell with water. The wetwell should be filled 24 hours prior to the time of testing to permit normal absorption into the wetwell walls. The wetwell shall be full at the start of the test.
 - 2) Leakage shall not exceed 0.2 gallons per hour per foot of head above the base over a four (4) hour period.
 - 3) Leakage shall be determined by refilling to the rim using a calibrated known-volume container, unless the volume can be accurately determined by measurement in a manner approved by the Owner's Representative and acceptable to the agency with jurisdiction.

3.6 FRESH WATER FOR TESTING.

- a. Fresh Water Testing Required. Contractor shall be responsible for obtaining sufficient water (*non-sewage, fresh water*) to fill the wetwell and to conduct the required wetwell and pumping tests. Potable water is not required for sewerage or stormwater pump stations.
- 1) If adequate water cannot be obtained from hydrants or watercourses in the vicinity of the pump station, the Contractor shall provide water trucks or other means of transporting required water.

PART 4: SPECIAL PROVISIONS

None.

SECTION 11785
FINE SCREENING EQUIPMENT

PART 1: GENERAL

1.1 SCOPE

- a. The work covered by this section consists of screenings removal, rinsing, and compaction equipment and controls to be installed at the headworks.
- b. All work performed under this section shall comply and be in accordance with approved trade practices and manufacturer's recommendations.

1.2 EQUIPMENT DESIGN AND PERFORMANCE CRITERIA

- a. The fine screening equipment shall meet the following design and performance criteria:
 - 1) Screen shall be designed for peak hour flow of 6.5 mgd at an influent suspended solids concentration of 250 mg/l. The influent to the screen shall be raw municipal sewage.
 - 2) Mechanical Specifications: Screen shall be perforated plate- or basket-type screen with ¼-inch or 6 mm holes. Screenings shall be automatically removed from plate or basket and shall pass through a cleaning and compaction zone or piece of equipment. Rinsed and compacted screenings shall be a grayish mass no less than 20% solids. Motor mounts and gear boxes shall be designed for use with American motors. Screen control panel shall be installed adjacent to the screen as shown on the drawings.
 - 3) Electrical Specifications: All electrical devices (except control panels) shall be Class 1, Division 1, group D rated and UL listed. All circuits within 10 feet of the equipment shall be intrinsically safe. Available power supply shall be 480-volt, 3 phase, 60 hertz. Any other step-down transformers necessary for ancillary equipment shall be included in the screen control panel. Control panel shall be installed outdoors.
 - 4) Controls/alarms: Control may be via relays/timers or PLC. Provide normally closed contacts that open on alarm condition wired to terminal blocks for the following signals between the equipment control panel and the plant main control panel shall be provided:
 - a) Fine Screen Alarm caused by motor overload, fine screen Jam (over current), emergency stop activation, and any other critical alarms associated with the equipment.
 - b) Bypass Level alarm.

- c) Control Power Fail.
- d) Screen running.
- e) HOA switch for screen drive in Hand position.
- f) HOA switch for screen basket spray wash in Hand position.
- g) HOA switch for press zone spray wash in Hand position.

5) Accessories:

- a) Stainless steel screenings discharge chute and support brackets.
- b) Unit-mounted emergency stop button
- c) Configuration. Screen shall be installed in a concrete channel as shown on the drawings.

1.3 MANUFACTURER'S REPRESENTATIVE

- a. The screen manufacturer shall furnish the service of a qualified representative to supervise the installation and start-up. A qualified manufacturer's representative shall be one who has had at least two years experience in the installation of the type of screens specified for this project.
- b. At the completion of the screen installation, the following certifications shall be submitted as a minimum and included in the front of the O&M manuals.
 - 1) Certification letter signed by the manufacturer's representative stating the following as a minimum:
 - a) The installations are as specified and are acceptable to the manufacturer.
 - b) The warranty and/or guarantee shall be in full effect during the warranty period with no qualifications or reservations.

1.4 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) Submittals for Record
 - a) The Contractor shall submit an installation and operation certificate and a statement from the manufacturer as outlined above.
 - b) Manufacturer's operations & maintenance instructions and warranty for all equipment items for inclusion in the O&M manuals as described in Section 01300.

2) Submittals for Review

- a) Complete shop drawings Including control panel construction drawings, control panel exterior elevations, control panel interior backpanel elevations, schematic drawings with field wiring termination points clearly defined shall be submitted to the Engineer for approval. All submittals shall be in accordance with the provisions of Section 01300, Submittals, and as specified herein.
- b) Descriptive literature, bulletins or other data describing the system equipment.
- c) Complete list of equipment and appurtenances included, complete, with manufacturer's name and model number.
- d) Complete bill of materials for all electrical & control components.
- e) General arrangement and dimension drawings.
- f) Name of warranty service available through factory authorized dealers or service contractors within a 100 mile radius of the installation.

1.5 OPERATION AND MAINTENANCE MANUAL

- a. A complete operations and maintenance manual detailing all operational procedures and maintenance requirements for all components of the system supplied shall be submitted in accordance with Section 01300.

1.6 WARRANTY

- a. Provide warranty for all equipment for one-year period from date of Certificate of Substantial Completion as described in the General Conditions.
- b. Provide copies of manufacturer's written warranties on various pieces of equipment.

1.7 ELECTRICAL AND CONTROLS COORDINATION

- a. If the current requirement of any motor or piece of equipment is increased to such an extent that the wiring, conduit and/or starter for that motor or equipment must be increased from that shown on the electrical drawings, the Contractor shall furnish and install the larger items. The increased wiring, conduit, and/or starter cost shall be provided at no additional cost to the Owner.

PART 2: PRODUCTS

2.1 GENERAL

- a. The physical layout of the system as well as the mechanical and electrical design shown on the contract drawings and the equipment specified herein is based upon the model HLSM500XL Helisieve spiral screening unit, as manufactured by Parkson Corporation.
- b. Alternative equipment shall be considered. However, if alternate equipment is proposed, the Contractor shall demonstrate to the Owner's Engineer and the Owner that all requirements of materials, performance, and workmanship have been met or exceeded by the equipment proposed. Contractors proposing manufacturers or equipment other than Parkson Corporation HLS500XL Helisieve spiral screening unit shall be responsible for all costs associated with system evaluation by the Owner's Engineer and redesign including all electrical, mechanical and civil aspects of the installation.
- c. The Helisieve unit shall consist of a spiral assembly, screen basket assembly, transport tube, press zone assembly, discharge section, drive system, pivot stand, non-moving stand, and controls. The unit shall be installed at 35 degrees in a 24-inch wide channel, and shall have a channel depth as shown on the Drawings. The Helisieve unit shall be equipped with a flexible neoprene discharge chute and a rigid type 304L stainless steel chute/guard and a discharge chute to the dumpster/screenings receptacle as shown on the drawings. The rigid stainless steel discharge chute shall pass through the blockout in the headworks structure to convey screenings to a dumpster. The end of the discharge chute shall be fitted with a bagger. The screen manufacturer shall provide all support equipment required to support the chute as shown on the drawings.
- d. The configuration of the screen within the channel and the discharge chute shall be in accordance with the contract drawings. The screen manufacturer shall review the drawings during the bidding phase of the project and shall provide the system as shown on the drawings.

2.2 SPIRAL ASSEMBLY.

- a. The spiral assembly shall consist of the spiral, brush and drive shaft.
- b. SPIRAL. The spiral shall be shaftless except in the press zone and discharge section and shall be constructed of high-strength carbon steel. The spiral shall be constructed of two concentric flights formed continuously from bar stock and welded together to form a spiral. The outer spiral shall have a thickness of 0.59 inches and the inner spiral shall have a thickness of 0.39 inch. The spiral shall have a constant inner diameter through the entire length. The spiral outer diameter shall be 7.68 inches in the transport section and shall transition to 17.13 inches in the basket with additional flight welded to the outer spiral.

- c. BRUSH. The spiral in the screen basket shall be fitted with a water-resistant brush, which shall clean the screen basket openings and be fastened to the trailing side of the spiral edge in the screen basket. Each brush section shall be molded into a plastic core and cover a 180 degree section of the spiral. Brush sections shall be mounted to form a continuous brush and clean the entire basket area during operation. The brush sections shall have stainless steel nuts pressed into the core and can be attached to the spiral with stainless steel fasteners.
- d. SHAFT. The spiral shaft shall be constructed of carbon steel and welded to the spiral. The shaft shall include a flange with a bolted connection to the drive shaft stub flange for ease of disassembly for maintenance.

2.3 SCREEN BASKET

- a. The screen basket shall be constructed of 11 gauge perforated type 304 stainless steel. The screen basket shall be fitted with rubber flaps to provide a seal between the channel walls and the screen basket. The screen openings shall be 1/4 inch diameter.
- b. BASKET SPRAY WASH SYSTEM. The spray wash system shall have plastic 1/4 turn nozzles to aid in the conveyance and washing of screened material. The spray system shall have an output of 15 GPM at 40 psig (19 GPM at 60 psi). Pipe and fittings shall be Schedule 40. A 3/4" NPT solenoid valve shall be provided to operate the water spray system automatically. The solenoid valve body shall be of brass.

2.4 TRANSPORT TUBE.

- a. The transport tube shall be constructed of 11 gauge type 304 stainless steel and shall include a tapered transition section to convey screenings from the screenings basket, through the straight transport section, and then to the press zone. The transport tube shall be fitted with four (4) wear bars in the transition section and four (4) wear bars in the straight section to prevent the spiral from wearing on the surface of the tube. The wear bars shall be constructed of .38" thick stainless steel. The wear bars shall be fixed to the taper and straight sections of the tube by cap screws inserted through the tube and threaded into tapped holes in the wear bars. This construction shall allow for ease of replacement and monitoring of wear rate on the bars by periodic removal and length measurement of the cap screws.

2.5 PRESS ZONE ASSEMBLY.

- a. The press zone assembly shall consist of a press zone enclosure, a retractable spool compaction tube, a spray flush system, and a discharge chute. A fully hinged top cover shall be provided to allow for easy access.
- b. PRESS ZONE ENCLOSURE. The press zone enclosure shall be mounted to the end flange of the transport tube, and be constructed of minimum 1/4" type 304 stainless steel. The enclosure shall include provisions to mount the gear reducer, compaction tube and

discharge chute. The enclosure shall have a top mounted hinged lid for full access to the press zone and discharge sections. The lid shall be secured with latches for easy access and have an interlock switch to stop the screen when the lid is open.

- c. **COMPACTION TUBE.** The compaction tube shall be flange mounted to the inside of the press zone enclosure. The bottom half of the tube shall have 1/8" perforations to drain the screenings pressate. An adjustable retractable spool compaction tube shall be adjustable according to the quantity of wipes in the influent flow. In retracted length mode, wipes, rags and screenings exit earlier to reduce clogging. In Standard length Mode, screenings compact for a full length. Designs without this feature are specially excluded.
- d. **SPRAY FLUSH SYSTEM.** The spray flush system shall have one spray header mounted to the enclosure, which shall flush the pressate into a discharge hose to be returned to the downstream side of the screen. The spray system shall have an output of approximately 8 GPM at 40-60 psi and can use non-potable water. Pipe and fittings shall be 1/2" NPT Schedule 40 stainless steel.
- e. **DISCHARGE CHUTE.** The discharge chute shall be bolted to the bottom of the press zone enclosure. It shall include a drain under the compaction tube, and have a discharge opening under the discharge section. The pressate and flush water shall be directed into a discharge hose to be returned to the downstream side of the screen. The discharge opening shall direct screenings to the solids receptacle or solids handling equipment.

2.6 TRANSPORT TUBE, SPRAY SYSTEM AND PRESS ZONE HEAT TRACING.

- a. The press zone, transport tube, and spray systems shall be fitted with 10 watt per foot, self-regulating heating cable rated for a Class I, Division 2 environment and wrapped with 1-1/2 inch thick closed cell foam insulation and enclosed with a 16 gauge type 304 stainless steel jacket. The basket and press zone solenoid valves shall be enclosed in a stainless steel enclosure with a hinged lid for operator access.
- b. **THERMOSTAT.** A NEMA 4X ambient sensing control thermostat suitable for Class I, Division 2 environment shall be mounted to the discharge section, shall be preset for 40 °F, and shall have a 3/4 inch NPT conduit connection. Electrical power shall be supplied from the main control panel.

2.7 DISCHARGE SECTION

- a. The discharge section shall be made of 11.81 inch ID 11 gauge type 304L stainless steel. A 360 degree reverse-pitched spiral on the shaft in the discharge zone shall prevent the plug from advancing into the drive. The reverse-pitched spiral shall have a serrated cutter to break the plug off and allow the solids to fall through a vertical tube, through a flexible neoprene discharge chute and into a rigid type 304L stainless steel discharge chute/guard and into a dumpster. An inspection/cleanout door in the vertical section of tube shall be

provided with an interlocked switch to prevent operation of the unit when the door is open. The screen manufacturer shall provide the stainless steel discharge chute above the headworks structure from the spiral section to the headworks floor penetration. The screen manufacturer shall also provide the stainless steel discharge chute below the elevated headworks structure from the floor penetration to the dumpster.

- b. The screen manufacturer shall provide a stainless steel discharge chute that passes through the blackout in the headworks structure to convey screenings to a dumpster below. The end of the chute shall be fitted with a bagging device. The screen manufacturer shall provide all supports required for the screen chute. All support materials shall be stainless steel.
- c. BAGGING DEVICE The end of the discharge section pipe shall be equipped with a bagging device to contain and enclose the pressed screenings. The device shall be fitted with a replaceable magazine of continuous clear plastic hose, 22 inches in diameter by 260 feet long, and 1.5 mils thick.

2.8 EXPLOSION-PROOF MOTOR AND REDUCER.

- a. The spiral drive system shall be fitted with a single speed, dual voltage, Class I, Division 1, Group D explosion-proof rated motor direct coupled via an AM143 C-face adapter, to a SEW-Eurodrive FAF type helical gear reducer. The electric motor shall be 1.0 HP, 1800 RPM, 230/460 volt, 3 Phase, 60 Hz, FCXP. The gear reducer shall be AGMA Class II service based on the horsepower required to operate the screen and shall have an output speed of 11 RPM.

2.9 PIVOT STAND.

- a. The unit shall have a support stand with integral pivot. The stand's structural members shall be constructed of stainless steel with a minimum thickness of 0.13 inch. The integral pivot shall allow rotation of the unit out of the channel and lateral pivoting above the channel for ease of maintenance.

2.10 SURFACE FINISH

- a. SURFACE TREATMENT OF STAINLESS STEEL COMPONENTS. All stainless steel subassemblies shall be acid passivated after welding for corrosion resistance and to provide a superior surface finish. This shall be done by full dipping of weldments; or by using an acid passivation paste in the weld and heat affected areas and spray-on acid solutions elsewhere. After passivation, the weldments shall be thoroughly rinsed with clean water and allowed to air dry. Sandblasting, bead blasting or grit blasting of stainless steel surfaces shall not be allowed in lieu of acid passivation.
- b. The spiral shall be prime coated for protection during shipment.

- a) The motor and gear reducer, and all unit-mounted electrical devices, shall have the standard manufacturer's finish.

2.11 ELECTRICAL DEVICES AND CONTROLS

- a. The influent channel is a Class 1, Division 1. Group D hazardous area. All electrical components located in the channel, within a 10 foot envelope around the equipment, or within an envelope 18" above the top of the channel wall and extending 10 feet horizontally from the channel wall shall be explosion proof or intrinsically safe. Motors shall be UL listed. Motor mounts and gear boxes shall be designed for use with American motors. CE motors and European mounts or gear boxes shall not be accepted.
- b. The screen manufacturer shall review the drawings and shall be responsible for verifying that all electrical components located within the above described hazardous area are explosion proof or intrinsically safe. Any electrical component located within the hazardous area and specified herein as not being explosion proof or intrinsically safe shall be upgraded by the manufacturer to explosion proof or intrinsically safe.
- c. ELECTRICAL DEVICES. In addition to the drive motor, the following electrical devices shall be furnished with each unit:
 - 1) EXPLOSION-PROOF SOLENOID VALVES. The 120 volt, single phase, 60 Hz solenoid valve housed in NEMA 7 enclosure shall have 18-inch-long integral leads.
 - 2) EXPLOSION-PROOF INTERLOCK SWITCH. The NEMA 7 access door interlock switch shall indicate when the press zone cover is opened.
 - 3) RADAR LEVEL TRANSMITTER. A 120VAC level controller shall be provided in a windowed NEMA 4X polycarbonate enclosure suitable for wall mounting. It shall be directly connected to an upstream radar level sensor. The controller shall have 3 relays outputs and have an LCD display for monitoring real time level readings and adjusting process setpoints. The controller shall be installed in a non-hazardous area. The radar level sensor shall be rated for installation in a Class 1, Div. 1 area. The sensor shall have a measuring range of 15m and be supplied with a 10m integral cable.
 - 4) EXPLOSION-PROOF EMERGENCY STOP LOCAL PUSH BUTTON STATION. A NEMA 7 emergency stop push button station shall be mounted to the support stand.
- d. CONTROLS. The following controls shall be provided:

- 1) A 480 volt primary U.L. listed and labeled control panel in a 4X type 304 stainless steel enclosure suitable for wall-mounting. It shall contain the following logic devices for proper operation of the equipment:
 - a) Programmable relay to monitor equipment mounted electrical devices to perform necessary logic functions.
 - b) Emergency Stop push button.
 - c) Hand-Off-Auto selector switches for the drive and spray washes.
 - d) Forward-Off-Reverse selector switch for the spiral drive.
 - e) Control power and spiral run incandescent indicating lights.
 - f) Spiral motor current monitor and hour meter.
 - g) Fault and fault reset push button incandescent light.
 - h) Run and fault auxiliary output contacts for customer use.
 - i) A step-down control transformer, IEC rated reversing motor starter and fused main disconnect shall be provided.

e. **SEQUENCE OF OPERATION**

- 1) **HAND OPERATION.** The spiral motor and spray wash shall run continuously.
- 2) **AUTOMATIC OPERATION.** The level sensor shall start the unit in the forward direction and the basket spray. After the upstream level has been lowered, the unit shall continue to run for the length of time set per the off delay timer, typically set at 30 seconds.
- 3) **Brush Saver Feature:** After forward operation is complete, or the high level sensor has been energized for an extended period, the unit shall stop and then operate in reverse for a short duration. This momentary reversal extends brush life by preventing bristles from being laid down in only one direction. Designs without this feature are specifically excluded.
- 4) The press zone spray wash shall provide a periodic flush based on the settings of an independent repeat cycle timer.
- 5) **EMERGENCY STOP.** The unit can be deactivated at any time by pressing either the control panel mounted or unit mounted Emergency Stop push button.
- 6) **FAULT CONDITIONS.** Motor overload or high current shall stop the drive motor and illuminate the fault light.

2.12 **FACTORY TESTING**

- a. The unit shall be factory operated and inspected prior to shipment. The Engineer and/or Owner may, at their option and own expense witness the factory test.

2.13 SPARE PARTS

- a. Brush with 1/4 quantity of clamps and fasteners.
- b. Five extra wear shoes.
- c. Fuses. One of each type, size and color provided.
- d. Indicator lens. One of each type, size and color provided.
- e. Terminal Blocks. Provide 12 spare terminal blocks on the terminal strip for future use.
- f. Package all spare parts specified in this section in a separate container clearly marked as "Fine Screen Spare Parts" and provide inventory list on exterior of the container.

2.14 ANCHOR BOLTS

- a. Contractor shall provide stainless steel anchor bolts as required to mount the equipment in accordance with the manufacturer's instructions. Contractor shall consult manufacturer for number, size, and type of anchor bolts during the bidding process. No additional payment shall be made to the Contractor for the Contractor's failure to coordinate mounting requirements during the bidding phase.

PART 3: EXECUTION

3.1 INSTALLATION

- a. The equipment shall be installed by the Contractor in accordance with manufacturer's recommendations.
- b. The Contractor shall coordinate specified equipment testing and startup requirements with the Division 16 Sub-Contractor, Instrumentation and Control Sub-Contractor, the Engineer and the Owner.

3.2 INSPECTION, START-UP AND FIELD TESTING

- a. The Contractor shall furnish a representative of the screen manufacturer to perform inspection, startup and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment.
- b. The representative shall check the installation and supervise initial startup of the equipment. The representative shall conduct performance testing and prepare written documentation describing the results. They shall certify that the installation is correct and that the equipment has operated satisfactorily.
- c. After the installation and operation of the equipment has been certified, the manufacturer's representatives shall train the City's personnel for one 8 hour period in the proper operation and maintenance of the equipment. This training session shall be in addition to the required startup and testing services. Therefore, a minimum of two site visits on non-consecutive days shall be required by the manufacturer's representative.

- d. If the General Contractor fails to prepare all systems needed for the manufacturer's representative to perform the required startup and testing, the representative shall make additional visits as required to complete the testing and training at no additional cost to the Owner.
- e. After the equipment has been placed into operation, the manufacturer's representative shall make all final adjustments for proper operation. Initial start-up shall include setting the ultrasonic level switch for the "Bypass Level Alarm" connection to the telemetry system. Each alarm connection to the telemetry system shall be tested.
- f. Warranty Service: As required during the warranty period.

PART 4: SPECIAL PROVISION

None.

DIVISION 13

SPECIAL CONSTRUCTION AND PROCEDURES

As noted in the specification submittal requirements, Contractor shall provide all of the electrical / control / telemetry / SCADA product data in Division 13 & Division 16 at the same time, unless specifically allowed otherwise in writing by the Owner's project electrical engineer. Piecemeal submittals will be returned as incomplete.

Existing Motor Starters & Controls.

See notes on Division 16 cover/divider page for requirements relating to investigation/testing by the electrical contractor to verify size of existing motors, prior to ordering any new equipment or components, and prior to installing new conduit or wiring.

SECTION 13100
PRE-ENGINEERED POST FRAME BUILDING

PART 1: GENERAL

1.1 SCOPE

- a. This specification section applies to the new storage building only and does not apply to the Blower Building or the DAF Building.
- b. The work performed under this section defines the products and work elements related to the provision of a Post Frame building system and associated accessories, complete and in accordance with the requirements of the Contract Documents. The scope of work includes:
 - 1) Pre-Engineered structural post frame building
 - 2) Pre-Engineered and shop fabricated trusses
 - 3) Roof panels
 - 4) Wall panels
 - 5) Accessories and trim
- c. The work performed under this section shall be in accordance with all approved trade practices and manufacturer's recommendations.

1.2 RELATED SECTIONS

- a. Section 08115 – Hollow Metal Doors and Frames
- b. Section 8361 – Sectional Overhead Doors

1.3 REFERENCES

- a. National Design Specification for Wood Construction (NDS)ANSI/AWC SDPWS: Special Design Provisions for Wind & Seismic
- b. Building Code Requirements for Structural Concrete (ACI 318)
- c. American Society for Testing and Materials (ASTM):
 - 1) A 446: Steel Sheet, Zinc-Coated (Galvanized) by the Hot-dip Process, Structural (Physical) Quality
 - 2) A 525: Steel Sheet, Zinc-coated (Galvanized) by the Hot-dip Process, General Requirements
 - 3) E 1514: Structural Standing Seam Steel Roof Panel Systems
- d. Oregon Structural Specialty Code (OSSC)

1.4 SYSTEM DESCRIPTION

- a. General: Provide a complete, integrated set of post frame building manufacturer's standard, mutually dependent components, and assemblies that form a post frame building system capable of withstanding structural and other loads, thermally induced

movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, roof and wall panels, and accessories complying with requirements indicated, including those in this Section.

- b. Post Frame Building System Design: Of size, spacing, slope, and spans indicated, and as follows:
 - 1) Primary Frame Type:
 - a) Rigid Clear Span: Solid-member structural-framing system without interior columns.
 - 2) End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, as follows:
 - a) Provide primary frame, capable of supporting one-half of a bay design load, and end-wall columns.
- c. Eave Height: As indicated by nominal height as shown on the Drawings.
- d. Bay Spacing: Manufacturer's standard, as indicated by the nominal spacing as shown on the Drawings.
- e. Roof Slope: 1 inch per 12 inches
- f. Roof System: Manufacturer's standard standing-seam roof panels with concealed fasteners.
- g. Exterior Wall System: Manufacturer's standard wall panels
- h. Accessories: All trim, rain gutters and downspouts.

1.5 DESIGN REQUIREMENTS

- a. Design requirements shall be as listed on the Drawings, General Structural Notes and the following specific paragraphs therein:
 - 1) Codes and Standards
 - 2) Design Loads – See page S001, “General Structural Notes.”
 - 3) Post Frame Building Components
- b. Deflection Criteria:
 - 1) In accordance with the applicable provisions of the OSSC.
 - 2) Applies to primary and secondary framing members, bracing members, roof panels, and wall cladding.
- c. Design Standards:
 - 1) OSSC 2019
 - 2) NDS 2018
 - 3) ACI 318-19

1.6 SUBMITTALS

- a. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the specific elements listed below.
- b. Shop Drawings: For the following Post Frame building system components. Include plans, elevations, sections, details, and attachments to other Work.
 - 1) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item).
 - 2) For installed components indicated to comply with design loads.
 - 3) Structural-Framing Drawings: Show complete fabrication of primary and secondary framing. Include connection details, distinguishing between shop and field applications. Include transverse cross-sections.
 - 4) Roof and Wall Panel Layout Drawings: Show layouts of panels on support framing, details of edge conditions, joints, panel profiles, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work.
 - 5) Door Schedule: Provide schedule of doors and frames, using the same reference numbers as indicated on Drawings. Include details of reinforcement and installation requirements.
 - 6)
- c. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - 1) Door headers and jambs – each condition.
 - 2) Gutters
 - 3) Downspouts
- d. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of the following products with factory-applied color finishes:
 - 1) Roof panels
 - 2) Wall panels
 - 3) Trim and closures
 - 4) Accessories
- e. Painting System: Specifications, include paint manufacturer's name, product trade name, and preparation for shop and field coats.
- f. Post Frame Building Manufacturer: Furnish name, address and manufacturing certificates as required by this Section.

- g. Erector: Furnish name and address documentation of past 5 years experience record to include project name, location, date of completion, building manufacturer and name and phone number of Owner's contact person.
- h. Structural Calculations Stamped by Engineer:
 - 1) Complete structural analysis package signed and sealed by the qualified professional engineer responsible for their preparation registered in the State of Oregon.
 - 2) Complete analysis and design of structural components and connections in accordance with design requirements indicated.
 - 3) Complete foundation design for all load cases.

1.7 WARRANTY

- a. General Warranty: Special warranties specified in this Section shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- b. Special Warranty: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Warranty. Special Warranty shall provide for correction, or, at the option of Owner, removal and replacement of Work specified in this Specification section. Warranty terms are as follows:
 - 1) Building manufacturer shall provide a Standard Limited Warranty of five (5) years.
 - 2) Standing Seam Roof and Wall Panel Weathertightness:
 - a) Terms: Furnish written, single source, no dollar limit warranty, stating standing seam metal roofing system, wall panel system and flashing under this Section will be maintained in watertight condition and defects resulting from the following items will be corrected without cost to Owner.
 - 1. Faulty workmanship.
 - 2. Defective materials including sealants and fasteners.
 - 3. Water infiltration.
 - 4. Weathertightness
 - b) Warranty Period: 20 years from date of Substantial Completion
 - 3) Roof and Wall Panel Finishes: Deterioration of finish including color fade, chalking, cracking, checking, blistering, peeling, and/or loss of film integrity.
 - a) Terms: Repair or replace
 - b) Warranty Period: 20 years from date of Substantial Completion

1.8 QUALITY ASSURANCE

- a. Professional Engineer Qualifications: A professional engineer licensed in the State of Oregon and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of Post Frame building systems that are similar to those indicated for this Project in material, design, and extent.
- b. Erector Qualifications: An experienced erector who has 5 years of experience specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

1.9 CONTRACTOR/POST FRAME BUILDING MANUFACTURER COORDINATION

- a. Post Frame building shop drawings shall be submitted and approved prior to forming of foundation concrete or fabrication of foundation reinforcing steel.
- b. Contractor shall verify interface of building components with the building foundation and coordinate required foundation revisions as required by the Post Frame building supplier with the Owner's Representative.
- c. Post Frame building supplier shall coordinate the size and configuration of all rough openings and flashing details with Contractor for Contractor installed doors

1.10 DELIVERY, STORAGE, AND HANDLING

- a. Protect building components and accessories from corrosion, deformation, and other damage during delivery, storage, and handling
- b. Store products in manufacturer's unopened packaging until ready for installation.
- c. Protect units from moisture damage during and after delivery. Store on wood blocking or pallets, flat and off ground, to keep clean and to prevent damage or permanent distortion. Cover with tarpaulins or other suitable weathertight and ventilated system.
- d. Protect finish of metal panels by application of removable plastic film or other suitable material placed between panels. Do not allow panels to come in contact with other material that would result in scratching, denting, staining or other damage to panel finish.

PART 2: PRODUCTS

2.1 STRUCTURAL FRAMING MATERIALS

- a. Bracing:
 - 1) Cable or wire rope systems are not acceptable for permanent bracing

- b. Bolted Connections:
 - 1) Primary Framing: ASTM A307 bolted connections.
 - 2) Secondary Framing: ASTM A307 or other dowel type fasteners such as lag screws, screws, and nails.

2.2 ROOF AND WALL PANELS

- a. General Material Requirements:
 - 1) Structural Quality Galvanized Steel Sheet: Hot-dip zinc-coated steel sheet in accordance with ASTM A446 with G90 coating complying with ASTM A525, Grade C.
 - 2) Structural Quality Aluminum-Zinc Alloy-Coated Steel Sheet: Hot-dip aluminum-zinc-coated steel sheet in accordance with ASTM A792 with Class AZ-50 coating; Grade 40.
 - 3) Finish: Polyvinylidene Fluoride: Kynar 500, two coats minimum for exterior panels over primer with a minimum total DFT 1.0 and 30 percent reflective gloss when tested according to ASTM D523. Baked polyester enamel at interior panels. Alternate two-coat fluoropolymer based coating systems may be submitted for review at the discretion of the manufacturer, however coating systems comprised of less than 70% PVDF will not be considered.
 - 4) Color for coating systems shall be as selected by Owner from manufacturer's standard colors.
- b. Wall Panel System:
 - 1) 24 gauge (0.0212 inch minimum uncoated metal thickness) minimum.
 - 2) Panel Sealants:
 - a) Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, non-toxic, non-staining tape 1/2 inch wide and 1/8 inch thick as recommended by metal building system manufacturer.
 - b) Joint Sealant: ASTM C 920; one-part elastomeric polyurethane, polysulfide, or silicone-rubber sealant; of type, grade, class, and use classifications required to seal joints in panels and remain weathertight; and as recommended by metal building system manufacturer.
- c. Roof Panel System:
 - 1) 24 gauge (0.0212 inch minimum uncoated metal thickness) minimum.
 - 2) Standing Seam Structural Roof Panel System: Steel panels in accordance with ASTM E1514.
 - 3) Panels shall be one piece from eave to ridge, with concealed clips and fasteners to purlins to allow for thermal movement over 120-degree ambient temperature range.

2.3 ACCESSORIES

- a. Exterior gutters shall be 24-gauge, G90 galvanized or aluminum-zinc alloy coated steel with the same finish as the wall panels. Color shall be selected by Owner from manufacturer's standard colors.
- b. Downspouts shall be 26-gauge, G90 galvanized or aluminum-zinc alloy coated steel with a color coordinated, pre-painted finish. Color shall be selected by Owner from manufacturer's standard colors.
- c. Standard rake trim shall be 26-gauge, G90 galvanized or aluminum-zinc alloy coated steel with the same finish as the wall panels. Color shall be selected by Owner from the manufacturer's standard colors. If the roof is a Standing Seam or Loc-Seam system, the rake shall be attached to the end-wall material with a slip joint, allowing the rake to expand and contract with the roof system.
- d. Wall trim shall be 26-gauge, G90 galvanized or aluminum-zinc alloy coated steel with the same finish as the wall panels. Color shall be selected by Owner from manufacturer's standard colors.
- e. Miscellaneous:
 - 1) Fasteners: Fasteners shall be manufacturer's standard plated/painted or long life fasteners with metal-backed neoprene washers. Exposed fastener heads shall be factory colored to match the panel color. Self-drilling fasteners shall be used throughout. Structural screws shall be used to secure panels to structural components. Stitch screws shall be used to secure panel to panel connections and trim screws shall be used at trim end laps.
 - 2) Blind Fasteners: High-strength aluminum or stainless-steel rivets.
 - 3) Furnish weatherstripping, sealants, roof jacks, roof curbs, gaskets, and other items as required for a complete installation.

PART 3: EXECUTION

3.1 EXAMINATION

- a. Examine supporting concrete foundation for compliance with requirements for installation tolerances and other conditions affecting performance of Post Frame building.

3.2 RECEIVING, STORAGE AND HANDLING OF MATERIALS ON JOBSITE

- a. All materials shall be unloaded, handled, hauled and delivered to storage by competent workmen in a manner which will prevent bends, dents, scratches and other damage. Damaged materials shall be rejected and promptly replaced. All materials shall be properly stored and protected from weather damage by the Contractor.

3.3 ERECTION – FRAMING

- a. Erect building system in accordance with manufacturer's standards and instructions.
- b. Furnish temporary guys and bracing for squaring, plumbing, and securing the structural framing against loads, such as wind loads acting on the exposed framing and seismic forces,

as well as loads due to erection equipment and erection operation, but not including loads resulting from the performance of work by others. Bracing furnished by the manufacturer for the Post Frame building system shall not be assumed to be adequate during erection. Temporary guys, braces, falseworks and cribbing shall be removed immediately upon completion of erection.

3.4 ERECTION – WALL AND ROOFING SYSTEM

- a. Wall and roofing materials shall be installed in accordance with manufacturer's instructions.
- b. Attach panels to structural supports to maintain a weathertight seal while allowing for thermal and structural movement.
 - 1) Install exposed fasteners in true vertical and horizontal alignment.
 - 2) Field seam side laps of standing seam roof panels using electrically operated seaming machine.
 - 3) Use proper tools to install screw fasteners to compress neoprene washer without damaging washer or stripping metal
- c. Install manufacturer's standard joint sealants, gaskets, and closure strips as required for weathertight installation.
- d. Field Cutting and Patching: Perform in manner to preserve appearance, weathertightness, or structural capacity of panel system.
- e. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surfaces.

3.5 INSTALLATION – GUTTERS AND DOWNSPOUTS

- a. Gutter shall be seamless.
- b. Install gutters with end pieces, outlet tubes, and other special pieces as required.
- c. Downspouts: Form from prefinished steel sheet in 10-foot- long sections, complete with formed elbows and offsets. Finish downspouts to match wall panels.
- d. Provide elbow at base of downspout to direct water away from building or tie into storm drain system.

3.6 INSTALLATION – ACCESSORIES

- a. General: Install-accessories according to manufacturer's written instructions, with positive anchorage to building and weathertight mounting. Coordinate installation with flashings and other components.
- b. Wall and roof accessories shall be sealed to be weathertight.

3.7 REPAIR, CLEANING, AND PROTECTION

- a. Immediately following erection, remove unused material, screws, fasteners, and other debris from completed installation. Use caution in removing metal cuttings from surface of prefinished metal panels.
- b. Replace damaged, dented, buckled, or discolored metal panels.
- c. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A780 and manufacturer's written instructions
- d. Repair damage to pre-finished metal components in accordance with the manufacturer's written recommendations.
- e. Protect work against damage until final acceptance. Replace or repair to the satisfaction of the Owner's Representative, any work that becomes damaged prior to final acceptance.

PART 4: SPECIAL PROVISIONS

None.

SECTION 13410
BASIC MEASUREMENT AND CONTROL INSTRUMENTATION MATERIALS AND METHODS

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) This Section contains the basic materials and methods required to install the measurement and control instrumentation system.

1.2 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.

- 2) Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Insulated Wire Ferrules (13410.F30).
 - 1) Ferrules shall be plastic sleeved and insulated.
 - 2) Ferrules shall be color coded per the DIN Standard.
 - 3) Provide Weidmuller ferrules, or approved equal.

PART 3: EXECUTION

3.1 INSTALLATION

- a. CONTRACTOR shall install and connect junction boxes, termination boxes, control panels, field devices, etc. as shown on the Drawings.
- b. Conductor Terminations.
 - 1) Provide ferrules on all conductors terminating on terminal strips.
 - 2) Ferrules shall be installed with a tool supplied by the ferrule manufacturer design specifically for that purpose.
 - 3) No more than one conductor shall be terminated on each side of a terminal block unless specifically shown otherwise on the Drawings.
- c. Terminal Block Jumpers.
 - 1) When connecting adjacent terminal blocks in a terminal strip to provide for common potentials, pre-manufactured bridge type jumpers supplied by the terminal manufacturer shall be used. These jumpers screw into and connect adjacent terminal blocks at the center of the terminal blocks.
 - 2) Comb type jumper shall not be used.
 - 3) Jumpers fabricated from short lengths of wire shall not be used.
- d. Twisted Shielded Pair (TSP) Cable Preparation.
 - 1) Strip cable insulation back only to the extent necessary to separate the individual conductors for termination. The shield shall be removed up to the point where the cable insulation has been removed.

- 2) Provide green heat shrink tubing on the full length of exposed drain wire from the point of termination back to where the cable insulation has been removed. The tubing shall be properly sized for the conductor and shall be shrunk after installation. Reference Section 16150 Wiring Connections for specification requirements for heat shrink tubing.
 - 3) The drain wire shall be grounded as indicated on the Drawings.
 - 4) Provide black heat shrink tubing at the point where the cable insulation has been removed. The tubing shall be 3 inches long and shall extend 1.5 inches up the insulation and 1.5 inches down the individual conductors. The tubing shall be properly sized for the cable and shrunk after installation. No part of the shield and no un-insulated part of the drain wire shall extend beyond this tubing. Reference Section 16150 Wiring Connections for specification requirements for heat shrink tubing.
- e. Equipment Grounding.
- 1) Each control panel, terminal box and junction box shall have a single grounding point consisting of a grounding bus bar. All grounding conductors terminating within the enclosure shall terminate on the ground bus. The ground bus bar shall be 100 percent copper with 10 percent spare opening for future use. Reference Section 16060 Grounding And Bonding for specification requirements for grounding bus bar.
- f. Conductor Splicing.
- 1) Conductors shall be spliced on terminal blocks installed for this purpose.
 - 2) Conductors shall only be spliced where identified on the Drawings.
 - 3) No other splicing methods shall be approved without prior approval by the ENGINEER.
- g. Instrument and Control Device Mounting Brackets.
- 1) The instrument/control device mounting bracket available from the manufacturer shall be provided and installed as directed unless a detail Drawing indicates a custom mounting bracket shall be provided.
- h. Terminal Block and Terminal Strip Identification.
- 1) Terminal blocks shall be identified as shown on the Drawings. Identification shall be provided on both sides of the terminal block. The plastic identification inserts shall be machine printed and provided by the manufacturer of the terminal blocks.
 - 2) Terminal strips shall be identified as shown on the drawings.
- i. Identification

- 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.

3.2 FIELD QUALITY CONTROL

a. Site Tests.

- 1) Control and instrumentation related conductors shall be tested for resistance to ground through the use of an ohm meter and visual damage to the insulation. Grounded conductors (neutrals and negative conductors) shall be isolated from the grounding system before testing.
- 2) High voltage “meggers” shall not be used.
- 3) A conductor shall be replaced if the resistance reading is less than one meg-ohm.
- 4) CONTRACTOR shall record the results of these tests on the Continuity Test Certification forms and submit them to the ENGINEER as specified in Section 16080 Electrical Testing.

END OF SECTION

SECTION 13420 INSTRUMENTS

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes
 - 1) This section includes the requirements pertaining to the measurement and control instruments.
- b. OWNER Furnished, CONTRACTOR installed instruments:
 - 1) The Instrument List in Supplement A of this Section shall define each instrument as follows:
 - a) OFCI = OWNER furnished, CONTRACTOR installed via the OWNER's SYSTEM INTEGRATOR (OSI).
 - b) CFCI = CONTRACTOR furnished, CONTRACTOR installed.
 - 2) CONTRACTOR shall coordinate with OWNER and OSI for delivery dates, access, installation sequencing, interfaces, and start-up/commissioning activities for all OFCI instruments.
 - 3) CONTRACTOR shall receive, inspect, store, and protect all furnished-by-others instruments (OFCI). CONTRACTOR shall notify OWNER/OSI of shortages or visible damage within 48 hours of receipt. After acceptance at site, CONTRACTOR shall be responsible for protection and for damage during handling, storage, or installation.
 - 4) Regardless of furnish designation, CONTRACTOR shall provide a complete installed system, including all labor and incidental materials required for proper operation (mounting/supports, conduit/cable, terminations, labels/tags, grounding/bonding, sealing fittings/glands, and required installation accessories not explicitly furnished with the instrument).
 - 5) CONTRACTOR shall provide all physical connectivity to enable OSI integration (power wiring, signal wiring/terminations, communication cabling/termination, and labeling). CONTRACTOR shall coordinate with OSI for configuration and programming.
 - 6) CONTRACTOR shall support loop checks and functional testing with OSI as specified in Section 16005.
 - 7) CONTRACTOR shall provide record documentation for installed instruments and terminations.

1.2 REFERENCES

- a. American National Standards Institute (ANSI).
 - 1) 51.1-1979 - (R1993) - Process Instrumentation Terminology.
 - 2) 5.1-1984 - (R1992) - Instrumentation Symbols and Identification.
- b. Instrumentation, Systems, and Automation Society (ISA).
 - 1) 5.3-1983 - Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.
- c. National Fire Protection Association (NFPA) 70 - National Electrical Code.
- d. National Electrical Manufacturer's Association (NEMA).
 - 1) 1-2000 - Industrial Control and Systems General Requirements.
- e. Underwriters Laboratory (UL).
 - 1) 508 - Industrial Control Equipment.
 - 2) 3121-1 - Standard for Safety for Process Control Equipment.

1.3 DEFINITIONS

- a. Manufacturer's Representative - manufacturer's authorized employee of the service division.

1.4 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted

for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

- 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.
- e. Quality Assurance/Control Submittals
 - 1) Manufacturers’ instructions for each item specified in PART 2 PRODUCTS.
 - a) Complete user manual including installation, wiring schematic, programming, calibration, communication, diagnostics, troubleshooting, recommended spare parts, and maintenance recommendations or requirements.

1.5 SEQUENCING

- a. CONTRACTOR shall not energize instrumentation until the completion of the continuity test certification and certification of installation by manufacturer’s representative.

1.6 SYSTEM START UP, COMMISSIONING, AND OWNER’S TRAINING

- a. Pursuant to Section 13490 Measurement and Control Commissioning.

PART 2: PRODUCTS

2.1 EQUIPMENT

- a. **Non-Hazardous Magnetic Flow Meter and Transmitter (13420.F51).**
 - 1) Magnetic flow meter shall be provided as shown on the Drawings with a remote transmitter.
 - 2) Provide a pair of ground rings for each meter installation. The ground rings shall be bonded to ground per the meter manufacturer’s instructions.
 - 3) Magnetic flow meters shall be rated for the area classification as specified on the Drawings.
 - 4) The meter body shall be diameter as shown on the Drawings.

- a) Flanged style with Class 150, A105, carbon steel flanges in accordance with ANSI B16.5.
- 5) The meter shall be equipped with a remote transmitter rated NEMA 4X and 120 volt AC input power. The transmitter shall display instantaneous flow rate and totalized flow. The meter shall be configured to permit the transmission of instantaneous flow rate over a 4-20mA DC output, provide a pulsed output for totalizing flow, all transmitted to the graphic data manager as shown on the drawings.
- 6) Magnetic flow meters shall indicate, totalize, and transmit flow information.
- 7) Magnetic flow meters shall use pulsed AC measurement technology. Pulsed DC measurement technology is not acceptable.
- 8) Magnetic flow meters shall include an auto-zero feature.
- 9) Magnetic flow meters shall compensate for eddy currents.
- 10) Magnetic flow meters shall be designed for bi-directional measurement of flow in a full pipe with fluid conductivity as low as 5 μ S/cm, without preamplifiers.
- 11) The electromagnetic induction flow meter shall generate a voltage linearly proportional to flow for full-scale velocity settings from one to 33 feet per second. Standard accuracy of the pulse output shall be $\pm 0.5\%$ of rate $\pm 0.05\%$ of full scale (33 ft/s) for all meters.
- 12) The flow meter shall be equipped with “heartbeat technology” which allows the end user the ability to verify calibration with the equipment left in place with their staff.
- 13) All components of the flow meter, including meter tube, sensors and recorder/totalizer shall be products of a single manufacturer.
- 14) The meter shall be provided with a minimum of 0.5% calibration.
- 15) The tests and the associated documentation will be able to be retained in an electronic format and convertible into a hard copy document compatible for customer review or printing. The technology is commonly referred to by the manufacturer as “Heartbeat Technology”. The data format will define all meter settings, ranges, fail-safes, and configuration detail to conform to these requirements. Sensor model, serial number, and test result will be identified for each verification in a date recorded format.
- 16) Magnetic flow meter flow tubes shall be factory assembled units comprised of a carbon steel spool piece and sensors.
 - a) Flow tube flanges shall be carbon steel, conforming to AWWA C110, and shall match the flange style of the piping to which they are connected.
 - b) Flow tubes shall be provided with stainless steel retention bolts.

- c) Flow liner shall be polyurethane.

17) Flowmeter Sensor:

- a) Magnetic flow meter sensors shall be solid state design, each with a pair of sensing electrodes, exciter coil, sensor reference coils, and internal grounding electrode.
- b) Magnetic flow meters shall be provided with a minimum of two opposed sensors to distribute the magnetic field over the entire cross-sectional area of the flow tube, and to allow continued operation and flow sensing, with reduced accuracy, in the event of a single sensor failure.
- c) Sensor grounding and sensing electrodes shall be stainless steel.
- d) Sensors shall automatically compensate for media noise including: electrochemical effects; entrained magnetic particles; particulate impact on electrodes; frictional effects against electrodes; variable conductivity; and coated electrodes.
- e) Sensor accuracy shall be unaffected by electrode coatings.
- f) The meter shall incorporate a high impedance amplifier of 1012 ohms or greater, eliminating the effect of buildup on the electrodes. The meter shall utilize bipolar pulsed DC coil excitation with automatic coil-current fine tuning by the microcontroller to adjust the sensor current within a tolerance of $\pm 100\text{mA}$. The amplifier shall incorporate 3-stage signal processing to maintain system accuracy by the use of a 26 bit analog/digital converter. The first stage will adjust the common-mode rejection ratio to filter out noise. The second stage will incorporate an INTEGRATED AUTOZERO function, which compensates for any external interference signals and eliminates zero drift. Manual zero adjustments shall not be required even at start-up. In stage three, the measuring signal will be amplified by an AUTOGAIN function, depending on the actual amplitude of the flow signal, to automatically increase the measurement resolution at various flow rates, providing a turndown of at least 1000:1. To further ensure the specified accuracy, the electronics shall automatically perform internal temperature drift compensation. Power consumption shall be no more than 15 VA, independent of meter size. Upon any power failure, the unit will retain all setup parameters and accumulated measurements internally in non-volatile memory. All units will be protected against voltage spikes from the power source by utilizing internal transient protection.
- g) Sensor Housing:
 - (1) Sensor shall be fully welded and protected for corrosion per EN ISO 12944 C5-M.
 - (2) Enclosure shall be IP66/67, Type 4X fully welded with protective coating.

18) Flowmeter Transmitter:

- a) The magnetic flow meter transmitter shall be integral with the sensor as one unit.
- b) The transmitter shall be microprocessor based with integral electronics. The flow meter shall have a 2-line push-button display used for programming as well as for simultaneous display of flow rate and total flow in user-selectable engineering units, and readout of diagnostic error

messages, selectable from 12 standard languages. The microprocessor shall safeguard against entering of invalid data for the particular meter size, and all programming parameters shall be access-code protected. The electronics shall include infinitely adjustable low flow cutoff.

- c) Transmitter power supply shall be 120VAC, or 24VDC as shown on the Drawings.
 - d) Transmitters shall be shielded or filtered from common RF noise effects including: radio transmissions; variable frequency drives; etc.
 - e) Transmitters shall be housed in a corrosion-resistant epoxy painted, cast aluminum, NEMA 4X (IP67) enclosure, suitable for conduit connections, and shall include a clear polycarbonate window to allow viewing of the display without opening the enclosure.
 - f) Transmitter operation, configuration, and calibration shall be via the keypad with visual prompts and built-in help at the LCD display.
 - g) The flow meter shall have the capability of being programmed remotely using HART/analog protocol.
 - h) Transmitter display shall indicate flow rate and/or total flow in user-selectable units of measure.
 - i) Transmitters shall include:
 - 1. Ethernet / IP network capability.
 - 2. Isolated, independently configurable 4-20 mA analog output. Response time shall be adjustable between 0.05 and 100 seconds.
 - 3. Configurable pulse output for volume units per pulse, or frequency proportional to flow rate. Frequency shall be adjustable up to 10kHz and pulse width shall be adjustable between 0.05 and 2 seconds.
 - 4. Totalizers for forward, reverse, net, and gross total flow, with user-specified volume units.
 - 5. Independently configurable contact inputs, programmable for measured value suppression, totalizer reset, or error-message reset.
- 19) The magnetic flow meter shall be an Endress+Hauser Proline Promag W 400 Series – OWNER furnished, CONTRACTOR installed.
- 20) Product Configuration as follows:
- a) XXXX Meter Body = Reference Mechanical Drawings for flow tube size.
 - b) AA Approval = Non-Hazardous Area
 - c) E Design = Fixed Flange
 - d) L Power Supply = 100-240VAC / 24 VAC/DC.
 - e) N Output; Input = Ethernet / IP.
 - f) M Housing = Compact, Polycarbonate.
 - g) 0 Cable, Remote Version = Not used.
 - h) D Electrical Connection = Thread NPT 1/2 inch.
 - i) U Liner = Polyurethane.
 - j) A1K Process Conn. = 150, carbon steel, flange joint, ASME B16.5
 - k) G Electrodes = 1.4435/316L Bullet Nose.
 - l) A Calibration = 0.5%
 - m) AA Operation Language Display = English
 - n) CA Sensor Option = IP66/67, Type 4X, welded corrosion protection
 - o) EB Application Package = Heartbeat Verification + Monitoring

b. Hazardous (C1D2) Magnetic Flow Meter and Transmitter (13420.F55).

- 1) Magnetic flow meter shall be provided as shown on the Drawings with a remote transmitter.
- 2) Provide a pair of ground rings for each meter installation. The ground rings shall be bonded to ground per the meter manufacturer's instructions.
- 3) Magnetic flow meters shall be rated for the area classification as specified on the Drawings.
- 4) The meter body shall be diameter as shown on the Drawings.
 - a) Flanged style with Class 150, A105, carbon steel flanges in accordance with ANSI B16.5.
- 5) The meter shall be equipped with a remote transmitter rated NEMA 4X and 120 volt AC input power. The transmitter shall display instantaneous flow rate and totalized flow. The meter shall be configured to permit the transmission of instantaneous flow rate over a 4-20mA DC output, provide a pulsed output for totalizing flow, all transmitted to the graphic data manager as shown on the drawings.
- 6) Magnetic flow meters shall indicate, totalize, and transmit flow information.
- 7) Magnetic flow meters shall use pulsed AC measurement technology. Pulsed DC measurement technology is not acceptable.
- 8) Magnetic flow meters shall include an auto-zero feature.
- 9) Magnetic flow meters shall compensate for eddy currents.
- 10) Magnetic flow meters shall be designed for bi-directional measurement of flow in a full pipe with fluid conductivity as low as 5 μ S/cm, without preamplifiers.
- 11) The electromagnetic induction flow meter shall generate a voltage linearly proportional to flow for full-scale velocity settings from one to 33 feet per second. Standard accuracy of the pulse output shall be $\pm 0.5\%$ of rate $\pm 0.05\%$ of full scale (33 ft/s) for all meters.
- 12) The flow meter shall be equipped with "heartbeat technology" which allows the end user the ability to verify calibration with the equipment left in place with their staff.
- 13) All components of the flow meter, including meter tube, sensors and recorder/totalizer shall be products of a single manufacturer.
- 14) The meter shall be provided with a minimum of 0.5% calibration.
- 15) The tests and the associated documentation will be able to be retained in an electronic format and convertible into a hard copy document compatible for customer review or printing. The technology is commonly referred to by the

manufacturer as “Heartbeat Technology”. The data format will define all meter settings, ranges, fail-safes, and configuration detail to conform to these requirements. Sensor model, serial number, and test result will be identified for each verification in a date recorded format.

- 16) Magnetic flow meter flow tubes shall be factory assembled units comprised of a carbon steel spool piece and sensors.
 - a) Flow tube flanges shall be carbon steel, conforming to AWWA C110, and shall match the flange style of the piping to which they are connected.
 - b) Flow tubes shall be provided with stainless steel retention bolts.
 - c) Flow liner shall be polyurethane.
- 17) Flowmeter Sensor:
 - a) Magnetic flow meter sensors shall be solid state design, each with a pair of sensing electrodes, exciter coil, sensor reference coils, and internal grounding electrode.
 - b) Magnetic flow meters shall be provided with a minimum of two opposed sensors to distribute the magnetic field over the entire cross-sectional area of the flow tube, and to allow continued operation and flow sensing, with reduced accuracy, in the event of a single sensor failure.
 - c) Sensor grounding and sensing electrodes shall be stainless steel.
 - d) Sensors shall automatically compensate for media noise including: electrochemical effects; entrained magnetic particles; particulate impact on electrodes; frictional effects against electrodes; variable conductivity; and coated electrodes.
 - e) Sensor accuracy shall be unaffected by electrode coatings.
 - f) The meter shall incorporate a high impedance amplifier of 1012 ohms or greater, eliminating the effect of buildup on the electrodes. The meter shall utilize bipolar pulsed DC coil excitation with automatic coil-current fine tuning by the microcontroller to adjust the sensor current within a tolerance of $\pm 100\text{mA}$. The amplifier shall incorporate 3-stage signal processing to maintain system accuracy by the use of a 26 bit analog/digital converter. The first stage will adjust the common-mode rejection ratio to filter out noise. The second stage will incorporate an INTEGRATED AUTOZERO function, which compensates for any external interference signals and eliminates zero drift. Manual zero adjustments shall not be required even at start-up. In stage three, the measuring signal will be amplified by an AUTOGAIN function, depending on the actual amplitude of the flow signal, to automatically increase the measurement resolution at various flow rates, providing a turndown of at least 1000:1. To further ensure the specified accuracy, the electronics shall automatically perform internal temperature drift compensation. Power consumption shall be no more than 15 VA, independent of meter size. Upon any power failure, the unit will retain all setup parameters and accumulated measurements internally in non-volatile memory. All units will be protected against voltage spikes from the power source by utilizing internal transient protection.
 - g) Sensor Housing:

- (1) Sensor shall be fully welded and protected for corrosion per EN ISO 12944 C5-M.
 - (2) Enclosure shall be IP66/67, Type 4X fully welded with protective coating.
- 18) Flowmeter Transmitter:
 - a) The magnetic flow meter transmitter shall be integral to the sensor as one unit.
 - b) The transmitter shall be microprocessor based with integral electronics. The flow meter shall have a 2-line push-button display used for programming as well as for simultaneous display of flow rate and total flow in user-selectable engineering units, and readout of diagnostic error messages, selectable from 12 standard languages. The microprocessor shall safeguard against entering of invalid data for the particular meter size, and all programming parameters shall be access-code protected. The electronics shall include infinitely adjustable low flow cutoff.
 - c) Transmitter power supply shall be 120VAC, or 24VDC as shown on the Drawings.
 - d) Transmitters shall be shielded or filtered from common RF noise effects including: radio transmissions; variable frequency drives; etc.
 - e) Transmitters shall be housed in a corrosion-resistant epoxy painted, cast aluminum, NEMA 4X (IP67) enclosure, suitable for conduit connections, and shall include a clear polycarbonate window to allow viewing of the display without opening the enclosure.
 - f) Transmitter operation, configuration, and calibration shall be via the keypad with visual prompts and built-in help at the LCD display.
 - g) The flow meter shall have the capability of being programmed remotely using HART/analog protocol.
 - h) Transmitter display shall indicate flow rate and/or total flow in user-selectable units of measure.
 - i) Transmitters shall include:
 6. Ethernet / IP network capability.
 7. Isolated, independently configurable 4-20 mA analog output. Response time shall be adjustable between 0.05 and 100 seconds.
 8. Configurable pulse output for volume units per pulse, or frequency proportional to flow rate. Frequency shall be adjustable up to 10kHz and pulse width shall be adjustable between 0.05 and 2 seconds.
 9. Totalizers for forward, reverse, net, and gross total flow, with user-specified volume units.
 10. Independently configurable contact inputs, programmable for measured value suppression, totalizer reset, or error-message reset.
- 19) The magnetic flow meter shall be an Endress+Hauser Proline Promag W 400 Series – OWNER furnished, CONTRACTOR installed.
- 20) Product Configuration as follows:
 - a) XXXX Meter Body = Reference Mechanical Drawings for flow tube size.
 - b) C6 Approval = CSA Class 1, Division 2 Group D rated.
 - c) E Design = Fixed Flange

- d) L Power Supply = 100-240VAC / 24 VAC/DC.
- e) N Output; Input = Ethernet / IP.
- f) M Housing = Compact, Polycarbonate.
- g) 0 Cable, Remote Version = Not used.
- h) D Electrical Connection = Thread NPT 1/2 inch.
- i) U Liner = Polyurethane.
- j) A1K Process Conn. = 150, carbon steel, flange joint, ASME B16.5
- k) G Electrodes = 1.4435/316L Bullet Nose.
- l) A Calibration = 0.5%
- m) AA Operation Language Display = English
- n) CA Sensor Option = IP66/67, Type 4X, welded corrosion protection
- o) EB Application Package = Heartbeat Verification + Monitoring

c. **Submerged Hydrostatic Level Transducer & Terminal Box Enclosure (13420.L10).**

- 1) Submerged hydrostatic level element shall be provided as shown on the Drawings.
- 2) Submerged hydrostatic level element shall be 24 VDC, loop powered.
- 3) CONTRACTOR shall determine correct sensor cable length based on installation requirements.
- 4) Submerged hydrostatic level element shall consist of variable capacitance, gauge pressure sensing assembly enclosed in submersible type 316 stainless steel housing with aluminum oxide ceramic sensor.
- 5) CONTRACTOR shall determine correct sensor range based on installation requirements.
- 6) Submerged hydrostatic level element seals shall be EPDM.
- 7) Submerged hydrostatic level element cables shall be mounted with cable-mounting screw.
- 8) Submerged hydrostatic level elements shall include a vented capillary tube that is protected from moisture intrusion by a Gore-Tex filter. The filter shall be located in the IP66/67 terminal box provided with the transmitter.
- 9) CONTRACTOR shall provide an enclosure for the IP66/67 rated terminal box to transition from cable into conduit back to the PLC.
 - a) Enclosure shall be NEMA 4X, type 304 stainless steel.
 - b) Enclosure shall have a steel interior mounting plate (back-panel).
 - c) Enclosure shall include a Gore-Tex filter ventilator.
- 10) Submerged hydrostatic level element signal output shall be analog with flexible scaling of 4-20 mA HART in proportion to level.
- 11) The accuracy shall be $\pm 0.2\%$ of the set span including hysteresis and non-repeatability; Long-term stability: $\pm 0.1\%$ of Upper Range Limit (URL) per year and must be capable of platinum accuracy of $\pm 0.1\%$ of the set span.

- 12) Provide intrinsically safe barrier / relay as required.
- 13) Provide Endress & Hauser Waterpilot FMX21 – OWNER furnished, CONTRACTOR installed.
- 14) Product configuration as follows:
 - a) CD Approval = CSA Class I, Div. 1, Grade A-D
 - b) 2 Output; Input = 4-20mA HART
 - c) 1 Probe Tube = 316L, d=0.87in
 - d) 1K Sensor Range = CONTRACTOR shall determine correct sensor range based on installation requirements.
 - e) G Reference Accuracy = Platinum.
 - f) E Calibration = inH2O/ftH2O
 - g) 25 Probe Connection = Shortable, PE cable. CONTRACTOR to determine lengths.
 - h) A Seal = FKM Viton
 - i) PO Accessory Enclosed = Suspension Clamp
 - j) PS Accessory Enclosed = Terminal Box, IP66/67
 - k) PU Accessory Enclosed = Additional Weight, 316L
- 15) For the terminal box enclosure, provide Hoffman enclosure, HJ1210HWLG, or approved equal. Provide Hoffman back-panel, A12P10, or approved equal. Provide Hoffman model ANMV3 ventilator – OWNER furnished, CONTRACTOR installed.

d. Radar Level Sensor and Display (13420.L20).

- 1) Radar level sensor shall be provided as shown on the Drawings with a display.
- 2) The pulsed time of flight radar transmitter shall operate at 26 GHz using 2-wire technology for level measurement and/or open channel flow measurement.
- 3) Accuracy shall be +/- 0.08" by application.
- 4) Maximum measurement distance shall be 0- 66 ft.
- 5) The radar output signal shall be 4-20 mA DC loop powered.
- 6) The radar unit shall be rated for IP66/68, NEMA4X/6P by application.
- 7) Transmitter housing shall conform to NEMA 4X classification.
- 8) Provide an Endress+Hauser Micropilot, FMR20 series – OWNER furnished, CONTRACTOR installed.
- 9) Product Configuration as follows:
 - a) CC Approval = CSA C/US NI Cl.1 Div.2 Gr. A-D
 - b) P Power Supply; Output; Operation = 2-wire; 4-20 mA HART/Bluetooth (App) configuration
 - c) CN Antenna; Max. Measuring Range = 80mm/3"; 10m liquid

- d) VCE Process Connection Rear Side = Thread ASME MNPT1; FNPT 1/2" conduit connection.
- e) RPF Process Connection Front Side = UNI slip on flange
- f) 1 Cable Length = 16ft.
- g) R3 Accessory Enclosed = Mounting Bracket adjustable, 316L

e. **Radar Flow Transducer and Transmitter (13420.L40).**

- 1) Radar flow transducers and transmitters and sensors shall be provided as shown on the Drawings.
- 2) Transmitters:
 - a) Radar level transmitters shall have automatic sensor detection.
 - b) Radar level transmitters shall be 120 VAC powered.
 - c) Radar level transmitters shall be capable of displaying envelope curves.
 - d) Radar level transmitters shall be NEMA 4X.
 - e) Radar level transmitters shall be capable of being configured for two (2) sensors.
 - f) Radar level transmitters shall be capable of being configured for two (2) analog 4-20mA outputs.
 - g) Radar level transmitters shall have illuminated 6-line display with keypad.
 - h) Radar level transmitters shall have one (1) SPDT relay.
 - i) Radar level transmitters and sensors shall be listed by a national testing laboratory that is recognized by the State in which they are installed.
 - j) Radar level transmitters shall have two (2) HART compatible 4-20 mA outputs.
- 3) Level Transducer:
 - a) Level transducer shall be capable of receiving level signal from the surface of the media utilizing radar technology.
 - b) Level transducer shall be 2-wire, 4-20mA HART, 24VDC loop powered, source derived from the transmitter.
 - c) Level transducer cable shall be pre-installed (factory potted).
 - d) CONTRACTOR shall determine correct sensor cable length based on the details provided in the Drawings.
 - e) Level transducer shall be capable of Bluetooth configuration.
 - f) Antenna shall be at minimum 40mm.
- 4) Manufacturer shall provide mounting brackets and hardware for each transducer. The sensor mounting dimensions in relation to the tank or channel walls shall be as shown on the Drawings.
 - a) All materials shall be stainless steel.
- 5) Provide an Endress & Hauser FlexView FMA90 transmitter – OWNER furnished, CONTRACTOR installed.
 - a) Product Configuration as follows:
 - (1) CA Approval = CSA General Purpose
 - (2) 1 Application = 100-230VAC

- (3) 1 Application Package = Universal (level, open channel flow measurement)
- (4) C Housing = Field Mounting, IP65, NEMA 4X
- (5) 4 Display = 3.5" TFT Touch Display, RJ45 Ethernet
- (6) 2 Sensor Connection = 2x 4-20mA/Hart input; 2x 4-20mA output
- (7) 1 Relay Output = 1x SPDT
- (8) A Digital Input = without
- (9) 0 Communication = Not Needed.
- (10) PB Accessory Enclosed = Weather protection over SST

6) Provide an Endress & Hauser Micropilot FMR20B – OWNER furnished, CONTRACTOR installed.

a) Product Configuration as follows:

- (1) FB Approval = CAN/US IS C1, D1
- (2) BA Output = 2-wire 4-20mA output
- (3) D Display = LED + Bluetooth
- (4) T Electrical Connection = Pre-Installed Cable
- (5) BM Antenna = PVDF Encapsulated 40mm
- (6) VCG Process Connection Cable = Threaded MNPT 1"
- (7) VEE Process Connection Antenna = Thread MNPT 1-1/2"
- (8) B Cable Length = 32ft

7) Provide an Endress & Hauser angle bracket for wall mounting, order #71452324, – OWNER furnished, CONTRACTOR installed.

a) Bracket shall be 316L stainless steel.

f. Non-Mercury Float Switch (13420.L61).

- 1) Non-mercury float switches shall be provided as shown on the Drawings.
- 2) Non-mercury float switches shall be designed for use in drinking water applications.
- 3) Non-mercury float switches shall be designed as an assembled unit incorporating a float body, snap-action SPDT microswitch, mechanical activation mechanism, cable, and protective strain relief.
- 4) Non-mercury float switches shall be direct acting.
- 5) Non-mercury float switches shall be rated for 250V/10A AC and 30V/5A DC.
- 6) Non-mercury float switch bodies shall be constructed from welded polypropylene. Adhesively assembled float switch bodies are not acceptable.
- 7) Non-mercury float switch bodies shall be 4" in diameter, minimum.
- 8) Non-mercury float switches shall include a 60 foot length cable.
- 9) Non-mercury float switches cables shall be multi-stranded, 3 conductor, 19 gauge, CPE jacketed cable.

- 10) Non-mercury float switches shall include an EPDM rubber protective sleeve to provide cable strain relief.
- 11) Provide Gems Sensors, Dwyer, Anchor Scientific – OWNER furnished, CONTRACTOR installed.

g. Pressure Transmitter (13420.P51).

- 1) Pressure transmitter shall be provided as shown on the Drawings.
- 2) Pressure transmitter shall be 24 VDC, loop powered.
- 3) The transmitter shall be a 2-wire, high-performance piezoresistive pressure transmitter with digital communications capabilities including 4-20 mA HART.
- 4) Measure capacitance changes in the sensor as pressure varies and produces a linear 4-20mA DC output proportional to the pressure. The unit shall have self-diagnostic capability and a non-volatile memory.
- 5) Pressure transmitter shall be rated for the Hazardous Location as shown on the Drawings.
- 6) The unit shall be rated for process temperature of minus 40°F to 275°F and an ambient environment of minus 40 degrees F to 185 degrees F.
- 7) Unit shall have ATEX, FM, CSA or IECEx approvals as required.
- 8) Provide Endress & Hauser Ceraphant PTP31B transmitter – OWNER furnished, CONTRACTOR installed.
- 9) Product configuration as follows:
 - a) CA Approval = CSA General Purpose
 - b) 7 Output; Input = PNP + 4-20 mA, IO Link, 4-wire
 - c) X Electrical Connection = Cable. [SPECIFY LENGTH].
CONTRACTOR to verify lengths.
 - d) 1P Sensor Range = 150 psi gauge
 - e) G Reference Accuracy = Standard 0.5%
 - f) F Calibration Unit = PSI
 - g) VUJ Process Connection = Thread ASME MNPT1/4, 316L

h. Rain Gauge (13420.R26).

- 1) Rain gauges shall be provided as shown on the Drawings.
- 2) Rain gauges shall be built to Nation Weather Service Standards.
- 3) Rain gauges shall be manufactured from epoxy-coated aluminum and anodized aluminum, or stainless steel.
- 4) Rain gauges shall be equipped with a spring loaded three-point adjustable base, with integral bubble and leveling screws for leveling the instrument.

- 5) Rain gauges shall include a magnetic reed switch.
 - a) Reed switches shall be normally open SPST.
 - b) Reed switches minimum contact rating shall be 3 watts at 24V DC.
 - c) Reed switch leads shall be brought out to terminal blocks to accommodate field wiring.
- 6) Rain gauge resolution shall be 0.01 inch of rainfall per bucket tip.
- 7) Rain gauge accuracy shall be 1% for 0 to 2 inches per hour.
- 8) Rain gauges shall include a removable stainless steel funnel screen.
- 9) Rain gauges shall include mounting brackets.
- 10) Provide NovaLynx model 260-2500, or approved equal.

PART 3: EXECUTION

3.1 INSTALLATION

a. General

- 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
- 2) Field wiring shall be installed according to the Drawings and manufacturer's instructions.
- 3) Wire and cable shall be connected from terminal to terminal without splices.
- 4) Wire and cable shall be arranged in a neat manner and securely supported in cable groups.
- 5) Wiring shall be protected from sharp edges and corners.
- 6) Float switches shall be installed using a stainless steel type CGB cord grip to seal the end of the conduit.
- 7) Transmitter connections shall be made using a terminal junction box, analog receptacles, and analog connectors as shown.
- 8) All equipment to be located as shown, and rigidly attached to walls or floor as shown or directed by Owner's Representative. Install all equipment in strict accordance with manufacturer's recommendations and in compliance with all rules and regulations of jurisdictions having authority. All work to be set plumb or level, as applicable, to be rigid and neat in appearance. Provide shop drawing of equipment and accessory layout and manufacturer's recommendations for installation and accessories before installing.
- 9) All piping shall be installed as shown on the plans or as directed by Owner's Representative.

- 10) All piping shall be supported as required to eliminate stresses on equipment including, but not limited to, the feed pump and chlorine tablet feeder.
- b. HDPE Mounting Plate
 - 1) HDPE Mounting Plate front edges shall be beveled as indicated on the Drawings to eliminate sharp edges.

3.2 ADJUSTING

- a. The representative shall check the installation and supervise initial startup of the equipment. He shall certify that the installation is correct and that the equipment has operated satisfactorily. In the case of the graphic data manager, the manufacturer's representative shall configure the device for downloading data to a Compatible USB memory stick (thumb drive) and assist the OWNER's staff in loading the Read Win PC 2000 software and the integration with the OWNER's existing MS Excel software for downloading spreadsheets to record flow measurements on a daily, weekly, monthly and annual basis.
- b. The overall accuracy of each instrumentation system or loop shall be as indicated in the specification for that system or loop. Each individual instrument shall have a minimum accuracy of ± 0.5 percent of full scale and a minimum repeatability of ± 0.25 percent of full scale unless otherwise indicated.
- c. The Contractor shall furnish a representative of the manufacturer to perform inspection, startup and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment.
- d. The representative shall check the installation and supervise initial startup of the equipment. He shall certify that the installation is correct and that the equipment has operated satisfactorily.
- e. After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the City's personnel in the proper operation and maintenance of the equipment.

END OF SECTION

SUPPLEMENT 13420-A
AUMSVILLE WASTEWATER TREATMENT PLANT
INSTRUMENT INDEX

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ITEM #	INSTRUMENT TAG NO.	P&ID	INSTRUMENT TYPE	DESCRIPTION	SPECIFICATION	FURNISH / INSTALL	MANUFACTURER	MODEL	LOOP DWG.	POWER
1	FE/FIT-2810	I011	C1D2 RATED FLOWMETER & TRANSMITTER (INTEGRAL)	PLANT PUMP STATION FLOWMETER (4-INCH)	13420.F55	OFCI (OSI)	E&H	PROMAG W 400	I103	24VDC
2	AIT-1030	I011	AUTOMATIC SAMPLER	HEADWORKS INFLUENT SAMPLER	11260	CFCI	HACH	AS950	I105	120VAC
3	FE/FIT-1020	I011	RADAR FLOW TRANSDUCER / TRANSMITTER	HEADWORKS PARSHALL FLUME FLOWMETER	13420.L40	OFCI (OSI)	E&H	FMR20B & FLEXVIEW FMA90	I105	120VAC
4	AIT-1040	I011	RAIN GAUGE	HEADWORKS RAIN GAUGE	13420.R26	OFCI (OSI)	NOVALYNX	260-2510	DISCRETE	N/A
5	ACV-2200	I012	SBR ACTUATED VALVE	SBR BASIN #1 AIR SUPPLY ACTUATED VALVE	N/A	OFCI (SSS)	AUMA	SQ SERIES	PER SUPPLIER	120VAC
6	ACV-2400	I012	SBR ACTUATED VALVE	SBR BASIN #2 AIR SUPPLY ACTUATED VALVE	N/A	OFCI (SSS)	AUMA	SQ SERIES	PER SUPPLIER	120VAC
7	SV-2201	I013	SBR SOLENOID VALVE	SBR BASIN #1 PURGE AIR SOLENOID	N/A	OFCI (SSS)	-	-	PER SUPPLIER	120VAC
8	FE/FIT-2250	I013	C1D2 RATED FLOWMETER & TRANSMITTER (INTEGRAL)	SBR BASIN #1 WAS FLOWMETER (3-INCH)	13420.F55	OFCI (OSI)	E&H	PROMAG W 400	I103	24VDC
9	AIT-2210	I013	SBR DO SENSOR	SBR BASIN #1 DO SENSOR & PROBE	N/A	OFCI (SSS)	YSI	IQ SENSORNET	PER SUPPLIER	24VDC
10	LIT-2211	I013	SBR LEVEL SENSOR	SBR BASIN #1 LEVEL SENSOR	N/A	OFCI (SSS)	FLYGT	LTU-801	PER SUPPLIER	24VDC LOOP
11	LSLL-2212	I013	SBR STORM FLOAT	SBR BASIN #1 STORM FLOAT SWITCH	N/A	OFCI (SSS)	FLYGT	ENM-10	PER SUPPLIER	24VDC
12	SV-2401	I014	SBR SOLENOID VALVE	SBR BASIN #2 PURGE AIR SOLENOID	N/A	OFCI (SSS)	-	-	PER SUPPLIER	120VAC
13	FE/FIT-2450	I014	C1D2 RATED FLOWMETER & TRANSMITTER (INTEGRAL)	SBR BASIN #2 WAS FLOWMETER (3-INCH)	13420.F55	OFCI (OSI)	E&H	PROMAG W 400	I103	24VDC
14	AIT-2410	I013	SBR DO SENSOR	SBR BASIN #2 DO SENSOR & PROBE	N/A	OFCI (SSS)	YSI	IQ SENSORNET	PER SUPPLIER	24VDC
15	LIT-2411	I013	SBR LEVEL SENSOR	SBR BASIN #2 LEVEL SENSOR	N/A	OFCI (SSS)	FLYGT	LTU-801	PER SUPPLIER	24VDC LOOP
16	LSLL-2412	I013	SBR STORM FLOAT	SBR BASIN #2 STORM FLOAT SWITCH	N/A	OFCI (SSS)	FLYGT	ENM-10	PER SUPPLIER	24VDC
17	LE/LIT-2500	I015	RADAR LEVEL SENSOR	EQUALIZATION BASIN LEVEL SENSOR	13420.L20	OFCI (OSI)	E&H	FMR20	I101	24VDC LOOP
18	LS-2501	I015	NON-MERCURY FLOAT SWITCH	EQUALIZATION BASIN OVERFLOW FLOAT SWITCH	13420.L61	OFCI (OSI)	FLYGT	ENM-10	DISCRETE	N/A
19	V-2505	I015	EQ BASIN CONTROL VALVE	EQUALIZATION BASIN ACTUATED CONTROL VALVE	11285	CFCI	AUMA	SA / GS SERIES	I104	120VAC
20	FE/FIT-2510	I015	RADAR FLOW TRANSDUCER / TRANSMITTER	EQUALIZATION BASIN FLOW CONTROL CHANNEL FLOWMETER	13420.L40	OFCI (OSI)	E&H	FMR20B & FLEXVIEW FMA90	I105	120VAC
21	LE/LIT-2801	I016	SUBMERGED HYDROSTATIC LEVEL TRANSDUCER	PLANT PUMP STATION LEVEL SENSOR	13420.L10	OFCI (OSI)	E&H	WATERPILOT FMX21	I101	24VDC LOOP
22	LSHH-2802	I016	NON-MERCURY FLOAT SWITCH	PLANT PUMP STATION HIGH-HIGH FLOAT SWITCH	13420.L61	OFCI (OSI)	FLYGT	ENM-10	DISCRETE	N/A
23	LSH-2803	I016	NON-MERCURY FLOAT SWITCH	PLANT PUMP STATION HIGH FLOAT SWITCH	13420.L61	OFCI (OSI)	FLYGT	ENM-10	DISCRETE	N/A
24	LSLL-2804	I016	NON-MERCURY FLOAT SWITCH	PLANT PUMP STATION LOW FLOAT SWITCH	13420.L61	OFCI (OSI)	FLYGT	ENM-10	DISCRETE	N/A
25	LIT-2901	I017	GENERATOR LEVEL SENSOR	BLOWER BUILDING GENERATOR FUEL TANK LEVEL SENSOR	16232	CFCI	ECHOPOD	DL14	I101	24VDC LOOP
26	PIT-3111	I019	PRESSURE TRANSMITTER	IRRIGATION PUMP #1 PRESSURE TRANSMITTER	13420.P51	OFCI (OSI)	E&H	CERAPHANT PTP31B	I101	24VDC LOOP
27	PIT-3112	I019	PRESSURE TRANSMITTER	IRRIGATION PUMP #2 PRESSURE TRANSMITTER	13420.P51	OFCI (OSI)	E&H	CERAPHANT PTP31B	I101	24VDC LOOP
28	FE/FIT-3131	I019	EXISTING INSTRUMENT	EXISTING IRRIGATION PUMP #3 FLOWMETER (6-INCH)	N/A	N/A (EXISTING)	N/A	N/A	I101	120VAC
29	FE/FIT-3140	I019	NON-HAZARDOUS FLOWMETER & TRANSMITTER (INTEGRAL)	IRRIGATION HEADER FLOWMETER (8-INCH, 0xDN)	13420.F51	OFCI (OSI)	E&H	PROMAG W 400	I103	24VDC

SUPPLEMENT 13420-A
AUMSVILLE WASTEWATER TREATMENT PLANT
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ITEM #	INSTRUMENT TAG NO.	P&ID	INSTRUMENT TYPE	DESCRIPTION	SPECIFICATION	FURNISH / INSTALL	MANUFACTURER	MODEL	LOOP DWG.	POWER
30	PSH-3151	I020	EXISTING INSTRUMENT	SLUDGE PIPE FLUSHING PUMP HIGH PRESSURE SWITCH	N/A	N/A (EXISTING)	N/A	N/A	I101	120VAC
31	PSL-3152	I020	EXISTING INSTRUMENT	SLUDGE PIPE FLUSHING PUMP LOW PRESSURE SWITCH	N/A	N/A (EXISTING)	N/A	N/A	I101	120VAC
32	FCV-3200	I021	DAF FLOW CONTROL VALVE (MODULATING)	DAF INFLUENT CONTROL VALVE	N/A	OFCI (DSS)	BRAY	SERIES 93 / 119 SOLENOID	PER SUPPLIER	120VAC
33	FIT-3201	I021	DAF FLOWMETER	DAF INFLUENT FLOWMETER	N/A	OFCI (DSS)	MCCROMETER	ULTRAMAG 5000	PER SUPPLIER	24VDC
34	PSL3242	I021	DAF PRESSURE SWITCH	DAF PNEUMATIC CONTROLLER PRESSURE SWITCH	N/A	OFCI (DSS)	ASHCROFT	DURALIFE SERIES	PER SUPPLIER	24VDC
35	SV-3243	I021	DAF SOLENOID VALVE	DAF PNEUMATIC CONTROLLER SOLENOID #1	N/A	OFCI (DSS)	ASCO	MODEL 8210	PER SUPPLIER	24VDC
36	SV-3244	I021	DAF SOLENOID VALVE	DAF PNEUMATIC CONTROLLER SOLENOID #2	N/A	OFCI (DSS)	ASCO	MODEL 8210	PER SUPPLIER	24VDC
37	FIT-3211	I021	DAF FLOWMETER	DAF RECYCLE FLOWMETER	N/A	OFCI (DSS)	MCCROMETER	ULTRAMAG 5000	PER SUPPLIER	24VDC
38	LIT-3231	I021	DAF LEVEL SENSOR	DAF CLARIFIER LEVEL SENSOR	N/A	OFCI (DSS)	TEK-TROL TEK-BAR	3110A SERIES	PER SUPPLIER	24VDC LOOP
39	LSH-3232	I021	DAF LEVEL SWITCH	DAF CLARIFIER OVERFLOW SENSOR	N/A	OFCI (DSS)	GEMS SENSORS	WARRICK SERIES (CONDUCTIVITY)	PER SUPPLIER	24VDC
40	SV-3219	I021	DAF SOLENOID VALVE	DAF ALTERNATE PURGE VALVE	N/A	OFCI (DSS)	ASCO	MODEL 8210	PER SUPPLIER	24VDC
41	TSH-3220	I021	DAF TEMPERATURE SWITCH	DAF SLUDGE PUMP TEMPERATURE SWITCH	N/A	OFCI (DSS)	INGERSOLL RAND ARO	PD20A PUMP	PER SUPPLIER	24VDC
42	V-3221	I021	DAF FLOW CONTROL VALVE (OPEN-CLOSE)	DAF PURGE VALVE #1	N/A	OFCI (DSS)	BRAY	SERIES 63 / 93 SOLENOID	PER SUPPLIER	24VDC
43	V-3222	I021	DAF FLOW CONTROL VALVE (OPEN-CLOSE)	DAF PURGE VALVE #2	N/A	OFCI (DSS)	BRAY	SERIES 63 / 93 SOLENOID	PER SUPPLIER	24VDC
44	V-3223	I021	DAF FLOW CONTROL VALVE (OPEN-CLOSE)	DAF RECYCLE FLOW CONTROL VALVE	N/A	OFCI (DSS)	BRAY	SERIES 63 / 93 SOLENOID	PER SUPPLIER	24VDC
45	AIT-3240	I021	DAF TURBIDITY SENSOR	DAF EFFLUENT TURBIDITY SENSOR	N/A	OFCI (DSS)	E&H	LIQUILINE CM442	PER SUPPLIER	120VAC
46	FCV-3245	I021	DAF FLOW CONTROL VALVE (MODULATING)	DAF EFFLUENT FLOW CONTROL VALVE	N/A	OFCI (DSS)	BRAY	SERIES 93 / 119 SOLENOID	PER SUPPLIER	120VAC
47	P-3250	I022	DAF CHEMICAL METERING PUMP	DAF POLYMER TANK #1 FEED PUMP	N/A	OFCI (DSS)	-	-	PER SUPPLIER	120VAC
48	P-3260	I022	DAF CHEMICAL METERING PUMP	DAF POLYMER TANK #2 FEED PUMP	N/A	OFCI (DSS)	-	-	PER SUPPLIER	120VAC
49	P-3270	I022	DAF CHEMICAL METERING PUMP	DAF COAGULANT TANK #1 FEED PUMP	N/A	OFCI (DSS)	-	-	PER SUPPLIER	120VAC
50	P-3280	I022	DAF CHEMICAL METERING PUMP	DAF COAGULANT TANK #2 FEED PUMP	N/A	OFCI (DSS)	-	-	PER SUPPLIER	120VAC
51	FS-3290	I022	EYEWASH FLOW SWITCH	EMERGENCY EYEWASH & SHOWER STATION FLOW SWITCH	11620	CFCI	HAWS	SP154DPDT	DISCRETE	N/A
52	LIT-3311	I023	RADAR LEVEL SENSOR	SALT DISSOLVING (BRINE) TANK	13420.L20	CFCI	E&H	FMR20	I101	24VDC LOOP
53	AE/AIT-3340	I023	GAS LEAK DETECTOR	HYDROGEN GAS LEAK DETECTOR	11240	CFCI	WALLACE & TIERNAN	ACUTEC 35	N/A	120VAC
54	LIT-3361	I024	HYPO TANK LEVEL SENSOR	HYPOCHLORITE (NACLO) STORAGE TANK LEVEL	11240	CFCI	E&H	WATERPILOT FMX21 (COROSSIVE RATED)	I101	24VDC LOOP
55	P-3371	I024	CHEMICAL METERING PUMP	CHLORINE METERING PUMP #1	11240	CFCI	PROMINENT	DIAPHGRAHM STYLE	PER MANUFACTURER	120VAC
56	P-3372	I024	CHEMICAL METERING PUMP	CHLORINE METERING PUMP #2 (SWING)	11240	CFCI	PROMINENT	DIAPHGRAHM STYLE	PER MANUFACTURER	120VAC
57	P-3373	I024	CHEMICAL METERING PUMP	CHLORINE METERING PUMP #3	11240	CFCI	PROMINENT	DIAPHGRAHM STYLE	PER MANUFACTURER	120VAC
58	FE/FIT-3401	I025	RADAR FLOW TRANSDUCER / TRANSMITTER	CHLORINE CONTACT CHAMBER EFFLUENT FLOWMETER	13420.L40	OFCI (OSI)	E&H	FMR20B & FLEXVIEW FMA90	I105	120VAC

SUPPLEMENT 13420-A
AUMSVILLE WASTEWATER TREATMENT PLANT
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(4) SSS = SBR SYSTEM SUPPLIER
(5) DSS = DAF SYSTEM SUPPLIER

ITEM #	INSTRUMENT TAG NO.	P&ID	INSTRUMENT TYPE	DESCRIPTION	SPECIFICATION	FURNISH / INSTALL	MANUFACTURER	MODEL	LOOP DWG.	POWER
59	FS-3500	I025	SULFUR INJECTOR FLOW SWITCH	SO2 CARRIER WATER FLOW SWITCH	11240	CFCI	SIGNET	515 ROTOR-X, AND 8900 READOUT	DISCRETE	120VAC
60	LCP-3510	I025	SULFUNATOR	DECHLORINATION SULFUNATOR	11240	CFCI	WALLACE & TIERNAN	V10K CHLORINATOR + SFC-SC	N/A	120VAC
61	WE-3521	I025	GAS TANK SCALE	SO2 TANK SCALE #1	11240	CFCI	FORCE FLOW	SOLO G2	I106	120VAC
62	WE-3541	I025	GAS TANK SCALE	SO2 TANK SCALE #2	11240	CFCI	FORCE FLOW	SOLO G2	I106	120VAC
63	WIT-3530	I025	GAS TANK SCALE	SO2 GAS SCALE TRANSMITTER	11240	CFCI	FORCE FLOW	SOLO G2	I106	120VAC
64	SV-3520	I025	SOLENOID VALVE	SO2 TANK #1 EMERGENCY VALVE CLOSURE	11240	CFCI	POWELL	E-PRO ELECTRONIC ACTUATOR	DISCRETE	120VAC
65	SV-3540	I025	SOLENOID VALVE	SO2 TANK #2 EMERGENCY VALVE CLOSURE	11240	CFCI	POWELL	E-PRO ELECTRONIC ACTUATOR	DISCRETE	120VAC
66	AE/AIT-3531	I025	GAS LEAK DETECTOR	SO2 GAS MONITOR	11240	CFCI	WALLACE & TIERNAN	ACUTEC 35	N/A	120VAC
67	AIT-3600	I025	AUTOMATIC SAMPLER	EFFLUENT SAMPLER	11260	CFCI	HACH	AS950	I105	120VAC
68	LIT-3901	I026	GENERATOR LEVEL SENSOR	DAF BUILDING GENERATOR FUEL TANK LEVEL SENSOR	16232	CFCI	ECHOPOD	DL14	I101	24VDC LOOP

END OF SUPPLEMENT

SECTION 13430
BOXES, CONTROL PANELS AND CONTROL CENTERS

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes
 - 1) This section contains the requirements pertaining to the construction and installation of the control panels.

1.2 References

- a. The following is a list of standards which may be referenced in this section:
 - 1) National Electrical Contractors Association (NECA)
 - 2) National Electrical Installation Standard (NEIS)
 - a) 5055, Standard of Installation
 - 3) National Fire Protection Association (NFPA)
 - a) 70, National Electrical Code (NEC)
 - b) 79, Electrical Standard for Industrial Machinery
 - 4) Underwriters Laboratories, Inc. (UL)
 - a) 3121-1, Standard for Safety for Process Control Equipment
 - b) 508, Industrial Control Equipment
 - c) 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations
 - 5) National Electrical Manufacturer's Association (NEMA)
 - a) 250, Enclosures for Electrical Equipment
 - b) ICS 1-2000, Industrial Control and Systems General Requirements

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they

are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

- 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
- 1) Pursuant to Section 01300 – Submittal Procedures.
 - 2) Manufacturer’s data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.
- e. Shop Drawings
- 1) Dimensional drawings showing the overall length, width, and height of the assembled control panel. Included on these drawings shall be the back panel layout of installed control devices showing part numbers, dimensions, nameplate text, and other details required for a complete assembly. The CONTRACTOR shall obtain the Drawings for the control panel layout and schematic from the ENGINEER. The CONTRACTOR shall modify the Drawings as required for submittal and for as-built documentation. The CONTRACTOR shall not generate their own drawings.
 - 2) For large control panel, physical properties, handling, mounting, shipping break point locations shall be shown in submittal drawings. This shall include total weight, lifting instructions, height, and floor space required.
 - 3) Provide electrical schematic drawings that include: wiring details such as internal and field connection terminal block numbers; shielded wire termination requirements; grounding requirements; and wire colors. Show all required internal and external interlocking. Each drawing shall be circuit specific for the system submitted. No typical schematic drawings shall be submitted.
 - 4) Drawings shall list the equipment number of the box, control panel, or center submitted.
 - 5) Component designations shall match those shown on the Drawings.

- 6) Complete bills of materials shall be included with submittal.

1.4 QUALITY ASSURANCE

a. Qualifications

- 1) Equipment provided as part of this section shall be manufactured by a single licensed firm, regularly engaged in the design and manufacture of such equipment for a minimum of five years. The control panels shall have a UL508A listing. Components within control panels shall be listed in a manner consistent with UL508A requirements.

1.5 MAINTENANCE

a. Manufacturer shall provide and list in the bill of materials the following spare parts.

- 1) One each of all power and control fuses provided in the assembled control panel/center.

b. Provide Operation and Maintenance Data and Manuals Pursuant to the Contract Documents.

PART 2: PRODUCTS

2.1 COMPONENTS

a. Enclosures (13430.E00).

- 1) Enclosures shall be provided as shown on the Drawings.
- 2) Enclosures shall be provided with accessories as shown on the Drawings and as specified below.
- 3) Enclosures in dry indoor locations shall be: constructed of steel (NEMA 12) with zinc electroplated (galvanized) steel back-panel; continuous hinged with gasketed doors.
- 4) Enclosures in damp, wet, corrosive, or outdoor locations shall be: constructed of stainless steel (NEMA 4X) with zinc electroplated (galvanized) steel back-panel, painted white.
- 5) Enclosures shall be continuous hinged with gasketed doors and screw down clamps.
- 6) Enclosures in outdoor locations shall be equipped with a hasp and staple for padlocking.
- 7) Provide Hoffman enclosures, or approved equal.

b. Panel Vents (13430.V01).

- 1) Panel Vents shall be provided as shown on the Drawings.
 - 2) Provide Hoffman number ANMV3, or approved equal.
- c. Enclosure Cooling Fan (13430.T01).
- 1) Enclosure cooling fans shall be provided as shown on the Drawings.
 - 2) Enclosure cooling fans shall operate on 115 VAC.
 - 3) Enclosure cooling thermostats shall be provided for each fan.
 - 4) Enclosure cooling fans shall be provided with air filter, air plenum, finger guard, and inlet grille.
 - 5) Enclosure cooling exhaust vents shall be provided for each fan.
 - 6) Enclosure cooling exhaust vents shall be provided with air filter, filter retainer with integral finger guard, and exhaust grille.
 - 7) Provide Hoffman model T-FP101 Filter Fan Packages, with Hoffman model A-TEMNO Thermostats, and Hoffman model TEP10 Exhaust Grills, or approved equal.
- d. Enclosure Heater (13430.H17).
- 1) Enclosure heaters shall be provided as shown on the Drawings.
 - 2) Enclosure heaters shall operate on 115 VAC.
 - 3) Enclosure heaters shall be provided with integral mounted thermostats.
 - 4) Provide Hoffman model DAH1001A, or approved equal.
- e. Weatherproof Fan/Filter (13430.F19).
- 1) Weatherproof fan/filters shall be provided as shown on the Drawings.
 - 2) Weatherproof fan/filters shall operate on 115 VAC.
 - 3) Weatherproof fan/filters shall be provided with air filter, air plenum, finger guard, inlet grille, and weatherproof shroud.
 - 4) Weatherproof exhaust vents shall be provided for each weatherproof fan/filter.
 - a) Weatherproof exhaust vents shall be provided with air filter, filter retainer with integral finger guard, exhaust grille, and fan shroud kit.
 - 5) Thermostats shall be provided for each weatherproof fan/filter.

- 6) Provide Hoffman model TFP101SS fan/filter, Hoffman model TEP10SS exhaust grille, Hoffman model T10S3RSS fan shroud kit, and Hoffman model A-TEMNO Thermostat, or approved equal
- f. Enclosure Lighting (13430.L01).
- 1) Enclosure lighting shall be provided as shown on the Drawings.
 - 2) Enclosure lighting shall be LED.
 - a) Lamp shall be provided by CONTRACTOR.
 - 3) Enclosure lighting shall be operated via a remote door switch.
 - 4) Enclosure lighting shall be 115 VAC powered.
 - 5) Provide Hoffman model LEDA1S35 light with door switch, or approved equal.
- g. Enclosure Corrosion Inhibitor (13430.I06).
- 1) Enclosure corrosion inhibitors shall be provided as shown on the Drawings.
 - 2) Provide Hoffman model AHCI10E, or approved equal.
- h. General Purpose Control Relays (24 VDC) (13430.R02).
- 1) General purpose control relays shall be provided as shown on the Drawings.
 - 2) General purpose control relays shall indicate the on/off status by either a neon indicating light, LED indicating light, or by mechanical means.
 - 3) General purpose control relays shall be compact 6.2 mm wide.
 - 4) General purpose control relays shall be single pole, double throw (SPDT), rated for 6A.
 - 5) General purpose control relay coil voltage shall be 24 VDC as indicated on the Drawings.
 - 6) General purpose control relays shall be mounted on DIN rail.
 - 7) Provide Allen-Bradley 700-HLT1Z24, or approved equal.
- i. Miniature "Ice Cube" Relays (24 VDC) (13430.R05).
- 1) Provide relays as shown on Drawings.
 - 2) Relays shall be industrial plug-in blade style with the on/off status indicated by either a neon or LED indicating light or by mechanical means.
 - 3) Relays shall be Form C contacts with a minimum of 4 poles and 7-amp contact rating.

- 4) Relay coil voltage shall be 24VAC.
 - 5) Provide with DIN rail mounting screw terminal socket and retainer clips.
 - 6) Relay bases shall be of the same manufacturer as the relay.
 - 7) Provide Allen-Bradley p/n 700-HC24A24 relays, p/n 700-HN104 screw terminal sockets, and p/n 700-HN114 retainer clips, or approved equal.
- j. Time Delay Relays (13430.R12).
- 1) Time delay relays shall be provided as shown on the Drawings.
 - 2) Time delay relays shall be either time delay on energize (TDOE), or time delay on de-energize (TDODE) as indicated on the Drawings.
 - 3) Time delay relays shall be provided with a timing range as indicated on the Drawings.
 - 4) Time delay relays shall be industrial plug-in blade style.
 - 5) Time delay relays shall indicate the timed out status by either a neon indicating light, LED indicating light, or by mechanical means.
 - 6) Time delay relays shall be provided with a minimum of three Form C contacts, and 10 Amp contact rating.
 - 7) Time delay relay coil voltage shall be either 120 VAC or 24 VDC as indicated on the Drawings.
 - 8) Time delay relays shall be provided with DIN rail mounting bases and hold down clips.
 1. Relay bases shall be of the same manufacturer as the relay.
 - 9) Provide Idec RTE Series, or approved equal.
- k. Power Circuit Breaker (13430.C02).
- 1) Power circuit breakers shall be provided as shown on the Drawings.
 - 2) Power circuit breakers shall be current-limiting and designed to interrupt and isolate electrical power to individual power circuits and components deriving power from the enclosure.
 - 3) Power circuit breakers shall be UL489 listed.
 - 4) Power circuit breakers shall have the number of poles as indicated on the Drawings.

- 5) Power circuit breakers shall have current interruption ratings of 10K RMS symmetrical amperes, minimum, with voltage ratings and current trip ratings as shown on the Drawings.
 - 6) Power circuit breakers shall have fast acting (type “B” trip curve), normal (type “C” trip curve) and high inrush (type “D” trip curve) trip characteristics as dictated by the connected load.
 - 7) Power circuit breakers shall be panel mounted on DIN rail.
 - 8) Power circuit breakers shall include a positively trip-free mechanism that cannot be defeated by holding the handle in the ON position.
 - 9) Power circuit breakers shall be wire connected and include terminal lugs.
 - 10) Provide Eaton Cutler-Hammer type FAZ-NA, or approved equal.
- l. Power Circuit Breaker Accessories (13430.C04).
- 1) Provide busbar for one-pole, two-pole or three-pole circuits when shown on the Drawings. The busbar shall be the same manufacturer as the power circuit breaker. Provide Eaton Cutler-Hammer busbar catalog number Z-SV/UL-16/___-___/_, or approved equal.
 - 2) Provide busbar shroud on all unused terminals. The shroud shall be the same manufacturer as the busbar.
 - 3) Provide Eaton Cutler-Hammer busbar shroud catalog number ZV-BS-UL, or approved equal.
 - 4) Provide a bus connector to supply the power feed to the bus bar as shown on the Drawings. The bus connector shall be the same manufacturer as the busbar.
 - 5) Provide Eaton Cutler-Hammer bus connector catalog number Z-EB/50/UL, or approved equal.
- m. Control Fuses (13430.F01).
- 1) Control Fuses shall be provided as shown on the Drawings.
 - 2) Control Fuses shall interrupt and isolate electrical power to individual control circuits and components within each enclosure and for circuits and components located outside each enclosure but deriving power from the enclosure.
 - 3) Control Fuses shall be rated at 250 VAC minimum and with current ratings as shown on the Drawings.
 - 4) Control Fuses shall have fast acting and time delay characteristics as dictated by the connected load.
 - 5) Provide five (5) spare fuses of each type and size provided for each control panel.

- 6) Provide Ferraz-Shawmut type GGM, or approved equal.
- n. Power Supply (13430.P02).
- 1) Power Supplies shall be provided as shown on the Drawings.
 - 2) Power supplies shall operate on 85 to 264V AC / 45 to 65 Hz.
 - 3) Power supplies shall withstand 300V AC short term voltage input.
 - 4) Power supplies shall be rated for 500,000 hours MTBF, minimum.
 - 5) Power supplies shall be rated for less than 15A inrush surge current.
 - 6) Power supplies shall include an internal slow-blow fuse.
 - 7) Power supplies shall include integrated varistors-based transient surge protection.
 - 8) Power supplies shall be adjustable from 22.5 to 29.5V DC output.
 - 9) Power supplies shall be rated for 5A DC output between -25 and 55 degrees Celsius.
 - 10) Power supplies shall be capable of being connected in parallel for increased capacity.
 - 11) Power supplies shall be current limited to 10A short circuit.
 - 12) Power supplies shall be rated for less than 40mV phase to phase residual ripple.
 - 13) Power supplies shall be rated for 3W power loss when idling.
 - 14) Power supplies shall be rated for 14W power loss under nominal maximum load.
 - 15) Power supplies shall include an LED to indicate DC power active.
 - 16) Power supplies shall include a relay contact to indicate DC power active.
 - 17) Power supplies shall be rated at 90% efficient, minimum.
 - 18) Power supplies shall be designed for DIN rail mounting.
 - 19) Power supplies shall be UL508 listed.
 - 20) Provide Phoenix Contact model 2866750 QUINT-PS1/AC24/DC5, or approved equal.
- o. Terminal Strip Identification Block (13430.T15).
- 1) Provide a terminal strip identification block with a machine generated label to match those shown on the Drawings.

- 2) Provide a Phoenix Contact marker carrier model number UBE/D, or approved equal.

p. Low Current Terminal Blocks (13430.T10).

- 1) Low current terminal blocks shall be provided as shown on the Drawings and in all panels requiring low current field terminations. Provide accessories as required and as shown including, but not limited to end anchors, end barriers, bridge jumpers, terminal strip pre-printed markers and snap-in pre-printed terminal block markers.
- 2) Low current terminal blocks shall be used for electrical circuits rated at or less than 30 amps.
- 3) Low current terminal blocks shall mount on DIN rail.
- 4) Low current terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
- 5) Low current terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.
- 6) Low current terminal blocks shall be grey in color.
- 7) Low current terminal blocks shall be UL rated for up to 30 amps at 600 VAC.
- 8) Low current terminal blocks shall accept wires from 24 to 10 AWG for single conductor per termination.
- 9) Provide Phoenix Contact model UK5N, or approved equal.

q. Grounding Terminal Blocks (13430.T60).

- 1) Grounding terminal blocks shall be provided as shown on the Drawings and in all panels requiring field terminations.
- 2) Grounding terminal blocks shall be used for electrical circuits rated at or less than 30 amps.
- 3) Grounding terminal blocks shall mount on DIN rail.
- 4) Grounding terminal blocks shall be UL rated for a maximum of 30 amps and 600 VAC and to accept wires from 26 to 10 AWG for single conductor per termination.
- 5) Grounding terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.

- 6) Low current terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.
 - 7) Grounding terminal blocks shall be green / yellow in color.
 - 8) Provide Phoenix Contact model USLKG5, or approved equal.
- r. Knife Disconnect Terminal Blocks (13430.T55).
- 1) Knife disconnect terminal blocks shall be provided shown on the Drawings, on all non-fused analog loop terminations, and in all panels requiring field analog loop terminations.
 - 2) Knife disconnect terminal blocks shall be used for analog circuits.
 - 3) Knife disconnect terminal blocks shall mount on DIN rail.
 - 4) Knife disconnect terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
 - 5) Knife disconnect terminal blocks shall be gray/orange in color.
 - 6) Provide Phoenix Contact model UK 5-MTK-P/P, or approved equal.
- s. Fusible DC Terminal Blocks (13430.T30).
- 1) Fusible DC terminal blocks shall be provided for 24 VDC control circuits as shown on the Drawings.
 - 2) Fusible DC terminal blocks shall be rated for use in electrical control circuits rated 6.3 amps or less and 15-30 VAC/DC.
 - 3) Fusible DC terminal blocks shall mount on DIN rail.
 - 4) Fusible DC terminal blocks shall accept 5 mm by 20, 25 or 30 mm fuses and use LED type blown fuse indicators.
 - 5) Fusible DC terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
 - 6) Fusible DC terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.
 - 7) Fusible DC terminal blocks shall be black in color.
 - 8) Provide Phoenix Contact model UK5 HESILED 24, or approved equal.
- t. Fusible AC Terminal Blocks (13430.T35).

- 1) Fusible AC terminal blocks shall be provided for 120 VAC control circuits as shown on the Drawings.
 - 2) Fusible AC terminal blocks shall be rated for use in electrical control circuits rated 6.3 amps or less and 110-250 VAC/DC.
 - 3) Fusible AC terminal blocks shall mount on DIN rail.
 - 4) Fusible terminal blocks shall accept 5 mm by 20, 25 or 30 mm fuses and use neon blown fuse indicators.
 - 5) Fusible AC terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
 - 6) Fusible AC terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.
 - 7) Fusible AC terminal blocks shall be black in color.
 - 8) Provide Phoenix Contact model UK5 HESILA 250, or approved equal.
- u. Single Wire Conductors (13430.C20).
- 1) Single wire conductors shall be provided as required for wiring within control panels and control centers.
 - 2) Single wire conductors shall be UL listed, standard type MTW.
 - 3) Insulation colors shall comply with Section 16121 600-volt Conductors and Cables.
 - 4) Single wire conductors shall be rated at a minimum of 600 volts.
 - 5) Single wire conductors for 120 VAC circuits shall be 14AWG minimum.
 - 6) Single wire conductors for motor power circuits shall be sized to the larger of; 125% of the attached motor load or 14AWG.
 - 7) Single wire conductors for transformer power circuits shall be sized to the larger of; 125% of the transformer rating or 14AWG.
 - 8) Single wire conductors for all other circuits shall be sized to the larger of; 100% of the attached load or 16AWG.
 - 9) Single wire conductors that leave the control panel shall be as specified in Section 16121 - 600 Volt Conductors and Cables.
- v. Single Pair Twisted Shielded Cable (13430.C25).

- 1) Single pair twisted shielded cables shall be provided as required for wiring within control panels and control centers.
 - 2) Single pair twisted shielded cable be twisted, single pair with a drain wire and overall foil shielding, and PVC jacket.
 - 3) Single pair twisted shielded cables shall be UL listed.
 - 4) Single pair twisted shielded cables shall be rated at a minimum of 300 volts.
 - 5) Single pair twisted shielded cable conductors shall be 18 AWG minimum, stranded, tinned copper.
 - 6) Single pair twisted shielded cables that leave the control panel shall be as specified in Section 16121 - 600 Volt Conductors and Cables.
 - 7) Provide Belden type 8760, or approved equal.
- w. Insulated Wire Ferrules (13430.F30).
- 1) Insulated wire ferrules shall be provided for all wiring within boxes, control panels, and control centers.
 - 2) Insulated wire ferrules shall be plastic sleeved and insulated.
 - 3) Insulated wire ferrule color code shall match DIN color code.
 - 4) Insulated wire ferrules shall be installed using a controlled cycle tool from the ferrule manufacturer and specifically intended for use with the ferrules provided.
 - 5) Provide Panduit, Thomas & Betts, or approved equal.
- x. Ring Cable Lug (13430.L80).
- 1) Ring cable lugs shall be appropriately sized for the conductor and for the lug or stud it is terminated on.
 - 2) The ring cable lugs shall be insulated in sized up to # 8 AWG and non-insulated on conductors larger than # 8 AWG.
 - 3) Ring cable lugs shall be made of high quality tin-plated electrolytic copper.
 - 4) Provide Phoenix Contact type C-RC ring cable lugs, or approved equal.
- y. Wire Identification Labels (13430.L02).
- 1) Wire identification labels shall be provided for all conductors within control panels and control centers.

- 2) Wire identification labels shall be machine printed, non-adhesive, wire marker heat shrink sleeves with identification numbers that match the approved submittals.
- 3) Wire identification labels shall be properly sized for the conductor or cable and shall be white with black characters.
- 4) Provide Brady, Panduit, or approved equal.

z. Wide Slot Wire Duct (13430.W20).

- 1) Wire ducts shall be provided as shown on the Drawings.
- 2) Wire ducts shall be sized as shown on the Drawings, or larger.
- 3) Wire ducts shall be no more than 40% filled based on the total cross sectional area of the wire duct.
- 4) Wire ducts shall be white in color.
- 5) Wire ducts shall have slotted sides.
- 6) Wire ducts shall include removable covers
- 7) Wire ducts shall be attached to the backpanel with screws or plastic fasteners that are approved for the use and provided by the wire duct manufacturer.
- 8) Wire ducts shall not be attached to backpanel or enclosure side surfaces with glue or other such adhesives.
- 9) Provide Panduit Type G, or approved equal.

aa. Narrow Slot Wire Ducts (Narrow Slot) (13430.W21).

- 1) Wire ducts shall be provided as shown on the Drawings.
- 2) Wire ducts shall be large enough to provide a wire fill area no more than 40 percent of the total cross sectional area of the wire ducts.
- 3) Wire ducts shall be attached to the back panel with screws or plastic fasteners that are approved for use with, and provided by the wire duct manufacturer.
- 4) Wire ducts shall not be attached to back panel or enclosure side surfaces with glue, tape, or other such adhesives.
- 5) Wire ducts shall be white in color.
- 6) Wire ducts shall have slotted sides.
- 7) Wire ducts shall be provided with removable covers.

- 8) Provide Panduit Type F, Thomas & Betts Type NPW, or approved equal.
- bb. Noise Shield (13430.N20).
- 1) Noise shields shall be provided as shown on the Drawings.
 - 2) Noise shields shall be designed to provide up to 20 dB reduction in noise, equivalent to six-inch air spacing.
 - 3) Noise shields shall be provided with bonding clips to allow mounting inside wire ducts.
 - 4) Noise shield height shall match the wire duct height.
 - 5) Noise shields shall be perforated and pre-scored.
 - 6) Noise shields shall include vertical wall slots and horizontal cable tie slots.
 - 7) Noise shields shall be zinc plated on all horizontal (contact) surfaces and black powder coated on all vertical surfaces.
 - 8) Noise shields shall be attached to the backpanel with screws or plastic fasteners that are approved for the use and provided by the wire duct manufacturer.
 - 9) Provide Panduit model SD(_)EMI, or approved equal.
- cc. Spiral Wrap (13430.W30).
- 1) Spiral wrap shall be provided as shown on the Drawings and for all conductor and cable wire assemblies that cross hinged connections.
 - 2) Spiral wrap shall be sized per the manufacturer's instructions.
 - 3) Spiral wrapped assemblies shall include a strain relieving loop at each hinge crossing, with a minimum 6 inch vertical height, to minimize flexing of the wires in the conductor and cable assemblies.
 - 4) Provide Panduit, Thomas & Betts, or approved equal.
- dd. Cable Ties (13430.W40).
- 1) Cable Ties shall be provided as required for organizing and arranging conductors within boxes, control panels, and control centers.
 - 2) Cable ties shall be UV resistant.
 - 3) Cable ties shall be black in color.
 - 4) Cable ties shall be installed using a tool from the cable tie manufacturer and specifically intended for use with the cable ties provided.

- 5) Provide Panduit, Thomas & Betts, or approved equal.
- ee. DIN Mounting Rail (13430.D10).
 - 1) DIN Mounting Rail shall be provided as shown on the Drawings and in all panels requiring DIN mounting rail.
 - 2) DIN mounting rails shall be made of steel, galvanized, and yellow chromated.
 - 3) Provide Allen Bradley, or approved equal.
- ff. Dual Outlet DIN Mounting GFCI Receptacles (13430.R88).
 - 1) Dual outlet DIN mounting GFCI receptacles shall be provided as shown on the Drawings.
 - 2) Dual outlet DIN mounting GFCI receptacles shall be rated for 20A at 120V AC.
 - 3) Dual outlet DIN mounting GFCI receptacles shall be suitable for use with wires up to #10 AWG.
 - 4) Dual outlet DIN mounting GFCI receptacles shall be rated for 25mS response time at 4-6 mA.
 - 5) Dual outlet DIN mounting GFCI receptacles shall comply with UL943.
 - 6) Provide Phoenix Contact model 5602519, or approved equal.
- gg. Ground Bars (13430.G06).
 - 1) Ground bars shall be provided as shown on the Drawings.
 - 2) Ground bars shall be low profile, “bus” type with set screw or pressure type connections and all copper construction.
 - 3) Ground bars shall include sufficient termination points to accommodate all equipment grounding conductors as shown on the Drawings.
 - 4) Ground bars shall include spare termination points to accommodate twenty (20) additional conductors sized, #14 through #8 AWG.
 - 5) Provide Cutler-Hammer model GBK21, GE model TGK42, Square D model PK27GTA, or approved equal.
- hh. Heavy Duty End Bracket (13430.A61).
 - 1) Provide heavy duty end brackets on DIN rails as indicated on the Drawings.
 - 2) Heavy duty end brackets shall be suitable for 35 mm DIN rails.
 - 3) End brackets shall be screw-on style.

- 4) Provide Phoenix E/AL-NS 35 series or approved equal.
- ii. Intrinsically Safe Relay (13430.R90).
 - 1) Intrinsically safe relay shall be a signal conditioner used for transfer of binary switching signals from a hazardous area.
 - 2) The input circuit shall be monitored for line faults (breakage and short circuit (LFD)).
 - 3) Errors on the intrinsically safe relay shall be indicated by a red flashing LED and the output shall switch to a high-impedance state.
 - 4) Intrinsically safe relay shall be two (2) channel.
 - 5) Provide Phoenix, part number 2865984 or approved equal.
- jj. Intrinsically Safe HART Barrier (13430.B90).
 - 1) Intrinsically safe HART barrier shall be a repeater power supply and input isolating amplifier. The repeater power supply and input signal conditioner shall be designed for the intrinsically safe and electrically isolated operation of measuring transducers and mA current sources installed in the hazardous areas.
 - 2) Intrinsically safe barrier shall be capable of supplying power to 2-wire transducers.
 - 3) Intrinsically safe barrier shall be capable of operating and measuring 4-wire transducers via a non-powered input.
 - 4) The analog measured value on the intrinsically safe or non-intrinsically safe side shall be capable of overlaying a digital (HART) communication signal and transmit bidirectionally.
 - 5) Intrinsically safe HART Barrier shall be single (1) channel.
 - 6) Provide Phoenix, part number 2865340 or approved equal.
- kk. Category 6 Ethernet Patch Cable (13430.C90).
 - 1) Category 6 Ethernet patch cable shall be provided for all Ethernet/IP networked devices.
 - 2) Category 6 Ethernet patch cable shall be suitable for use as Industrial Ethernet Cable, 100BaseTX.
 - 3) Category 6 Ethernet patch cable shall be rated for use in a temperature range between -10 degrees C and 60 degrees C.
 - 4) Category 6 Ethernet patch cable shall be rated for outdoor use.

- 5) Category 6 Ethernet patch cable shall be rated for 300 volts maximum.
 - 6) Category 6 Ethernet patch cable conductors shall be 4-pair, solid copper, 24 AWG.
 - 7) Category Ethernet patch cable conductor pairs shall be bonded.
 - 8) Category 6 Ethernet patch cable insulation material shall be Polyolefin.
 - 9) Category 6 Ethernet patch cable insulation color shall be blue.
 - 10) Category 6 Ethernet patch cable shall be provided with aluminum foil polyester tape shield with 100% insulation coverage.
 - 11) Category 6 Ethernet patch cable outer jacket material shall be PVC. Jacket material shall be sunlight and oil resistant. Jacket shall have sequential markings at two foot intervals.
 - 12) Category 6 Ethernet patch cable shall be provided with RJ45 plugs, suitable for IP20 applications.
 - 13) Category Ethernet patch cable shall be Belden Data Tuff Industrial Ethernet Cord Set E505 Series, or approved equal.
- II. Fiber Optic Bend Radius Control Fin (13430.Z01).
- 1) Provide bend radius control fins in the control panel to coil excess fiber optic patch cord and incoming fiber optic cables. Bend radius control clips shall be used to maintain the manufacturer's minimum recommended bending radii.
 - 2) Clips shall be Panduit FMFIN series or approved equal.

PART 3: EXECUTION

3.1 INSTALLERS

- a. All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
- b. CONTRACTOR shall install and connect junction boxes and control panels and to field devices as shown on the Drawings.
- c. For all conductors terminating on terminal strips, install crimp-on, insulated plastic sleeve ferrules on each wire. Install ferrules with a crimping tool provided by the ferrule manufacturer for that purpose.
- d. Individual conductors and cables shall be grouped together and routed through plastic wire ducts mounted on the backpanel surface.
- e. Bond each enclosure back-panel to the grounding electrode system with a # 8 AWG copper conductor.

- f. Where conductors and cables are routed in boxes or enclosures, they shall be neatly bundled with cable ties at intervals not to exceed 12 inches on center. The tension for the cable ties shall be set with a tool specifically made for this purpose and of the same manufacturer as the cable tie. Side cutters or other type tools shall not be used to cut the tail end of the cable tie. The CONTRACTOR shall only use the tool specifically made for this purpose and designed for use with the cable ties provided.

3.2 SOURCE QUALITY CONTROL

a. Tests and Inspections

- 1) CONTRACTOR shall notify the ENGINEER 14 days prior to commencement of shop testing. All equipment shall be tested prior to site delivery.
- 2) CONTRACTOR-developed test forms shall accompany the notification of testing.
 - a) Test forms shall list all field connections at terminal strips and all internal logic circuits, along with the method planned for simulation of field conditions to test these connections and circuits.
- 3) All analog instrument loops shall be tested using an analog signal generator by applying the appropriate control signal to the field termination terminal strip.
 - a) At a minimum, analog instrument tests shall be made at 0%, 25%, 50%, 75%, and 100% of maximum control signal.
 - b) Additional analog instrument tests shall be made as appropriate.
- 4) All digital control circuits shall be tested by: applying the appropriate control voltage to the field termination terminal strip when externally supplied; using a jumper at the field termination terminal strip when internally supplied; or, if applicable, at an internal panel connection point when field terminations are not used.

b. Verification of Performance

- 1) Device functions shall be observed by the ENGINEER, to determine satisfactory operation of the device and connected circuit continuity, prior to shipment.

3.3 FIELD QUALITY CONTROL

a. Site Tests, Inspection

- 1) CONTRACTOR shall install, calibrate and test, all systems prior to notifying ENGINEER of witness testing verification.
- 2) The ENGINEER shall utilize the Process Control Test Certification included in Section 16005 Starting and Adjusting to systematically verify the process control system is operating as designed. The CONTRACTOR shall perform the tasks necessary to confirm proper operation to the ENGINEER.

END OF SECTION

SECTION 13450
CENTRAL CONTROL

PART 1: GENERAL

1.1 SUMMARY

- a. The OWNER's System Integrator (OSI) will supply the control panels CP-200 and CP-300.
- b. The CONTRACTOR shall install control panels CP-200 and CP-300.
- c. The OSI will provide, install and configure the new WWTP SCADA systems. CONTRACTOR is responsible for coordinating with the OSI for integration and termination of all equipment, instruments, devices for a complete and functional system.
- d. The OSI will provide all the software and configure the PLC, HMI's and SCADA.
- e. The CONTRACTOR shall review the process narrative and P & ID Drawings and then schedule a meeting with the OWNER and ENGINEER to review the documents together and address any questions the CONTRACTOR may have before starting their Work.
- f. The OSI working under a separate Contract will provide PLC programming software, and all associated programming. The System Integrator will review the process narrative and P & ID drawings and meet with the OWNER and ENGINEER shortly after receiving the Notice To Proceed (NTP) to answer any questions they may have and to review the screen development requirements. The System Integrator shall prepare sample screens and meet with the OWNER and ENGINEER to review their development and modify the screens and operation as directed. The OWNER and ENGINEER shall approve the appearance and operation of the screens before they are installed.

1.2 REFERENCES

- a. The following is a list of standards which may be referenced in this section:
 - 1) National Electrical Contractors Association (NECA)
 - 2) National Electrical Installation Standard (NEIS)
 - 3) 5055, Standard of Installation.
 - 4) National Fire Protection Association (NFPA)
 - 5) 70, National Electrical Code (NEC).
 - 6) 79, Electrical Standard for Industrial Machinery.
 - 7) Underwriters Laboratories, Inc. (UL)
 - 8) 3121-1, Standard for Safety for Process Control Equipment.

- 9) 508, Industrial Control Equipment.
- 10) National Electrical Manufacturer's Association (NEMA)
- 11) 250, Enclosures for electrical equipment.
- 12) ICS 1-2000, Industrial Control and Systems General Requirements.

1.3 SYSTEM DESCRIPTION

- a. The central control provides for monitoring and alarming of the system process.

1.4 SUBMITTALS – NOT USED

PART 2: PRODUCTS – NOT USED.

PART 3: EXECUTION

3.1 INSTALLATION

- a. All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
- b. Installation shall be pursuant to the manufacturer's instructions, specifications and the Drawings.

END OF SECTION

SECTION 13490
MEASUREMENT AND CONTROL COMMISSIONING

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes
 - 1) The section includes the requirements pertaining to the checkout, calibration, and testing of the instrumentation provided as part of this project.
 - 2) Supplement 13490 – A; Process Control Narrative.

1.2 SYSTEM START UP, COMMISSIONING, AND OWNER’S TRAINING

- a. General
 - 1) CONTRACTOR shall provide the OWNER with a written notice a minimum of four calendar days prior to system start-up. The project schedule shall not be sufficient notice.
 - 2) CONTRACTOR shall conduct System Start Up, Commissioning and OWNER's Training pursuant to the general instructions in Sections 01650 - Starting of Systems, 16001 - Commissioning, 16005 - Starting and Adjusting, and 16015 - Demonstration and Testing. CONTRACTOR shall follow the instructions given in each section which are specific to instrumentation and control of the station.
- b. Checkout
 - 1) After installation and connection work has been completed, CONTRACTOR shall verify the equipment is properly installed.
 - 2) CONTRACTOR to verify the following
 - a) Polarity of electric power and signal connections.
 - b) Correct applied voltages to all equipment.
 - c) Required grounds are properly connected.
 - d) The integrity of all connections.
 - 3) CONTRACTOR shall certify in writing each loop or system has been verified for proper installation.
- c. Calibration
 - 1) CONTRACTOR shall provide labor, tools, and equipment to calibrate each instrument in accordance with the manufacturer’s specifications and instructions.
 - 2) Analog instruments shall be calibrated and tested in place without removal.
 - 3) Test equipment and instruments used to simulate inputs and read outputs shall be suitable for the purpose intended and shall be calibrated to accuracy greater than

the required accuracy of the instrument being calibrated. Test equipment shall have accuracy traceable to the National Bureau of Standards.

d. Analog Loop Tests

- 1) CONTRACTOR shall provide labor, tools, and equipment to field test, inspect and adjust each instrument installed under this contract to its specified performance requirement in accordance with manufacturer's specifications and instructions.
- 2) Instruments provided by CONTRACTOR which fails to meet any contract requirement or any published manufacturer performance specification for functional and operational parameters not specified in the contract, shall be repaired or replaced, at no cost to OWNER.
- 3) Each element of the analog loop shall be tested and exercised by the CONTRACTOR to demonstrate proper operation, first individually and then as a complete loop.
- 4) Each analog loop shall be tested to verify proper performance within specified accuracy tolerances.

e. System Testing

- 1) The CONTRACTOR shall notify the ENGINEER a minimum of 14 days in advance of the scheduled system testing.
- 2) System testing shall not commence until after approved acceptance of all wire, calibration, and loop tests.
- 3) All systems shall be tested prior to the beginning of plant operational testing.
- 4) Completion of system testing activities shall be documented by a certified report, including all test forms, with test data entered, furnished to ENGINEER.
- 5) System testing shall at a minimum demonstrate the following:
 - a) Each component of the system operates properly with all other components of the system.
 - b) Analog control loops operate in a stable manner.
 - c) Interlocks perform properly.
 - d) Control sequences perform properly.
- 6) System testing activities shall include the use of water to establish service conditions simulating normal final control element operating conditions in terms of applied process loads, operating ranges and environmental conditions.
- 7) Final control elements, control panels and supplementary equipment shall be tested under start up and steady state operating conditions to verify proper and stable control is achieved using all control center and field mounted control circuits associated with each system.

- 8) Hardwired and software control circuit interlocks and alarms shall be operational.
 - 9) Control of final control elements and supplementary equipment shall be tested using both manual and automatic control circuits.
 - 10) Stable steady state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers, to eliminate oscillatory final control element operation.
 - 11) CONTRACTOR shall submit to ENGINEER a copy of completed test reports specified in this Section and Section 16080 - Electrical Testing.
- f. System Start Up
- 1) After system Calibration and Testing verification is complete, CONTRACTOR shall inform the ENGINEER in writing that the station controls are installed according to the Drawings and that the station is ready for Start Up.
 - 2) When Start Up begins, the CONTRACTOR shall have his technicians available on site at all times during testing to aid the ENGINEER.
 - 3) After ENGINEER has verified all installed control systems are operating properly, commissioning may commence.
- g. Commissioning
- 1) CONTRACTOR shall then perform Commissioning as follows:
 - a) Operating the station for 14 consecutive days without a significant interruption with the exception of any interruption caused by training conducted during this time period.
 - b) The station shall be operated in every designed control mode including the operation of all equipment.
 - 2) Should a significant interruption occur the fault causing the interruption shall be corrected by the CONTRACTOR and the Commissioning period of 14 consecutive days shall be restarted.
- h. OWNER's Training
- 1) Coordinate with OWNER.

PART 2: PRODUCTS – NOT USED.

PART 3: EXECUTION

3.1 Supplement 13490 – A; Process Control Narrative.

END OF SECTION

SUPPLEMENT 13490-A
CITY OF AUMSVILLE
WASTE WATER TREATMENT PLANT
PROCESS NARRATIVE

PART 1 INTRODUCTION

This document provides a narrative description of the operation and control scheme for the City of Aumsville Wastewater Treatment Plant.

The Wastewater Treatment Plant is located in the northwest portion of the City. The site address is 955 Olney Street. The plant consists of the following unit processes.

- 1.1 Headworks with a fine screen, an influent flow measurement flume, influent flow meter, rain gauge, automatic sampler, and plant pump station flow meter.
- 1.2 Two sequencing batch reactor (SBR) treatment tanks that include aeration equipment, mixers, level sensors, dissolved oxygen sensors, waste sludge pumps, waste sludge flow meters, and a decanter.
- 1.3 An equalization basin that includes level sensors, an actuated butterfly valve for flow control, a flow measurement weir, and an open channel flow meter.
- 1.4 A chlorine contact chamber for use during the winter discharge season. The contact chamber also includes an effluent flow measurement weir and flow meter, a carrier water pump for the sulfur dioxide system, and a drain pump.
- 1.5 A blower building that includes the blowers for the SBR, the air control valves for the SBR, and an electrical and control room for the plant.
 - (1) The electrical and control room houses:
 1. Blower Building Main Plant PLC (CP-2000)
 2. SBR System Control Panel (CP-2100)
 3. SBR System Motor Control Center (MCC-2000)
- 1.6 A dissolved air floatation (DAF) building that includes the DAF clarifier system for polishing lagoon effluent during the winter months, the onsite chlorine generation system for the disinfection of the final plant effluent. A flocculant and polymer feed system for the DAF equipment, two air compressors that provide high pressure air for the DAF equipment, a tepid water eyewash and safety shower system, and an electrical control room.
 - (1) The DAF building electrical and control room houses:
 1. DAF Building Main Plant PLC (CP-3000)
 2. DAF System Control Panel (CP-3105)
 3. DAF Motor Control Panel (CP-3100)
 4. DAF Building Motor Control Center (MCC-3000)

- 1.7 A dechlorination building that houses the sulfur dioxide gas feed equipment used during the winter months to dechlorinate the effluent prior to discharge to Beaver Creek.
- 1.1 An irrigation/DAF pump station that includes three irrigation pumps that are used to pump effluent to the primary effluent reuse site during the summer months. A fourth irrigation pump is used to irrigate the small effluent reuse site located the treatment plant. This pump will be re-purposed to serve as a flushing pump to occasionally flush the sludge piping from near the DAF building to the sludge storage lagoon. The station also includes the DAF pumps that pump lagoon effluent into the DAF clarifier. An irrigation flow meter located near the existing irrigation filter adjacent to the irrigation pump station. The DAF pump flow meter is located on the tube flocculator inside the DAF building. The DAF flow meter is part of the DAF equipment package.
- 1.2 A primary effluent reuse site consisting of a center pivot irrigation system and associated control system located south of the City.
- 1.3 A small effluent reuse site located at the treatment plant.
- 1.4 A facultative sludge storage lagoon for treatment and storage of waste sludge from the SBR process.
- 1.5 Three effluent storage lagoons that are used to store effluent during the spring and fall storage seasons.
- 1.6 A plant pump station that is used to pump the various drains and sanitary drainage to the headworks. The headworks is equipped with a flow meter on the plant pump station force main pipe for flow monitoring.
- 1.7 A compliance manhole with an effluent sampler.
- 1.8 Backup power system.

The treatment plant is designed to discharge treated effluent to Beaver Creek from November through April. During the months of June through September, treated effluent is typically disposed by irrigating cropland at the City's reuse site located south of the City. The City also has a small reuse site at the treatment plant property. During the non discharging months of May and October, treated effluent from the SBR process is stored in the storage lagoons.

The Blower Building Main Plant Control Panel (CP-2000) and the DAF Building Main Plant Control Panel (CP-3000) are the two primary controllers of the treatment system. The panels are networked to one another via a GNS-1115AC Secure Wireless Bridge, maintaining a continuous Ethernet/IP connection between the two buildings.

CP-2000 houses a fiber optic switch that connects the treatment plant to the City's network infrastructure. A 12-strand multimode fiber optic cable runs from the Blower Building to a fiber optic switch located in a wall-mounted swing rack at the Administration Building, where the treatment plant is networked into the City's SCADA system.

The following sections include descriptions of each unit process.

PART 2 HEADWORKS

The headworks receives wastewater from the Main Pump Station on a year around basis. Since flow is pumped to the headworks, the flow through the headworks is intermittent. The headworks provides a location to screen the raw wastewater, measure flows, take influent samples, and split the flow between the two SBR basins.

- 2.1 Influent Flow Measurement. The headworks includes a flow measurement flume with an ultrasonic flow meter and an automatic sampler. The flow meter is monitored by the **Blower Building PLC (CP-2000)** and then the PLC sends the sampler a digital sample command. These signals are transmitted to the **Blower Building Main Plant PLC (CP-2000)**. The operator interface for the **CP-2000** has a screen to display the following information.
 - (1) Instantaneous influent flow in gallons per minute
 - (2) Total influent flow in millions of gallons since commissioning
 - (3) Total influent flow today in millions of gallons
 - (4) Total influent flow yesterday in millions of gallons
 - (5) Total influent flow this month in millions of gallons
 - (6) Total influent flow last month in millions of gallons
- 2.2 Influent Sampling. The influent sampler is used to collect time based or flow proportional composite samples. Therefore, the signal from the influent flow meter is connected to the sampler. The influent sampler is not equipped with a pH or temperature probe. The City will collect pH and temperature data using their hand-held equipment.
- 2.3 Fine Screen. The headworks includes a fine screen with a manufacturer-supplied control panel. The system integrator shall coordinate with the manufacturer and the design team to determine the monitoring requirements for the screen.
- 2.4 Flow Splitting Weirs. The headworks includes sluice gates on the outlet pipes to split the flow to each SBR basin. The gates are manually operated. Under normal operations, all wastewater is split equally between the two SBR basins. There is no instrumentation associated with the flow splitting weirs.
- 2.5 Rain Gauge. The rain gauge does not have a local readout. The rain gauge includes of a tipping bucket that sends a pulse signal after each tip of the bucket. Each tip of the bucket corresponds to a calibrated rainfall depth. The pulse signal from the rain gauge is transmitted to the **CP-2000**. The operator interface for the **CP-2000** has a screen to display the following information.
 - (1) Total rainfall today in inches
 - (2) Total rainfall yesterday in inches
 - (3) Total rainfall this month in inches
 - (4) Total rainfall last month in inches
- 2.6 Plant Pump Station Flow Meter. The headworks also includes a magnetic flow meter on the plant pump station forcemain pipe. This flow meter is used to track plant pump station flows separately from the total influent flow. Signals from this flow meter are transmitted to the **CP-2000**. The operator interface for the **CP-2000** has a screen to display the following information.
 - (1) Instantaneous influent flow in gallons per minute
 - (2) Total plant pump station flow in millions of gallons since commissioning
 - (3) Total plant pump station flow today in millions of gallons
 - (4) Total plant pump station flow yesterday in millions of gallons
 - (5) Total plant pump station flow this month in millions of gallons

- (6) Total plant pump station flow last month in millions of gallons

PART 3 SEQUENCING BATCH REACTORS

The sequencing batch reactor equipment is being supplied as an equipment package from Xylem – Sanitaire. The package includes the blowers, the air control valves, the aeration equipment, the mixers, the waste sludge pumps, the decanters, the level control instruments, the dissolved oxygen sensors, a local control station for each basin, a motor control center for the variable frequency drive and other motor control equipment, and a control panel that controls the system. The system integrator shall coordinate with the manufacturer and the design team to determine the appropriate monitoring requirements for the SBR equipment.

PART 4 EQUALIZATION BASIN

The purpose of the EQ basin is to equalize the flow from the SBR to the downstream processes. The discharge rate from the SBR is intermittent. Water flows from the SBR to the EQ basin only during the decant phase for each of the SBR units. The downstream processes are not well suited for flow of this nature. Therefore, the EQ basin provides flow equalization to attenuate the intermittent discharge from the SBR thus creating a more constant flow stream for the downstream processes.

- 4.1 Equalization Basin Flow Control Valve. The primary element controlling the discharge rate from the EQ Basin is an actuated butterfly valve. The actuator opens and closes the valve to maintain a relatively constant discharge rate. A level transducer will be used to monitor the water level in the EQ basin. A float switch is used to signal backup level control and an alarm condition.

The control signal for the valve position shall be provided by the CP-2000 via a 4-20 mA signal to the valve actuator. When this analog signal is equal to 4 mA, the valve is closed. When it is equal to 20 mA, the valve is fully open. Additionally, the CP-2000 will monitor the actual valve position using a 4-20 mA signal from the actuator (% opened, % closed). The logic that generates the valve position signal shall be contained in the programming of the CP-2000. The programming logic that controls the valve actuator is based on the flow signal from the EQ basin flow meter and the level transducer in the EQ basin. The EQ basin flow meter is located in a channel immediately downstream of the EQ basin.

The SCADA system shall include a screen to show the status of the EQ basin control system. As a minimum this screen shall show the operation mode of the valve, the water level in the EQ basin, the effluent flow rate, the valve position signal, the actual valve position, and overflow alarm status. Other screens shall be provided to adjust the set points, such as operating parameters for the actuated valve.

- 4.2 EQ Basin Level Sensors. The water level in the EQ basin shall be monitored continuously using a new level transducer. A float switch will be used to signal an overflow alarm.
- 4.3 EQ Basin Control Modes. The control system shall have the following three modes of operation as follows.
- (1) Mode 1: Automatic operation with variable discharge rate. In mode 1, the water level in the EQ basin is controlled automatically. This is performed by cycling between two effluent flow rates that are calculated for each batch. The first flow rate is used during decant and the second rate is used between decants. It is important to note that this control scheme must

have an operator selectable variable that indicates how many basins are online. During the summer months, the City will likely only operate one SBR basin. During the winter months, the City will likely operate two SBR basins. Therefore, the time between decants will be different depending on how many basins are in service. The number of basins online may potentially be provided by signals from the SBR control panel if these signals are available.

1. During decant – During a decant, the objective is to discharge effluent at rate that will result in the EQ basin reaching the full level at the end of the decant phase. This will maximize the attenuation capabilities of the basin. Immediately prior to starting decant, the CP-2000 will read and calculate parameters that will be used to control the EQ basin during the decant:
 - (1) Decant volume
 - (2) Decant time
 - (3) EQ basin water level
 - (4) EQ basin max. water level at end of decant (set-point)
 - (5) Available storage volume in the EQ basin: equal to (4) minus (3), multiplied by the EQ basin volume per foot of depth.
 - (6) Volume to discharge during the decant cycle: equal to (1) minus (5).
 - (7) Discharge rate during the decant cycle: equal to volume (6) divided by time (2).

During the decant cycle, use discharge rate (7) as the flow rate setpoint to modulate the actuated control valve. If this value is negative, then the discharge rate shall be set equal to the average plant inflow rate during the last four hours.

2. Between decants – Between decants the objective is to discharge at a rate that will empty the basin immediately prior to the next decant thereby maximizing the available storage volume in the basin prior to the next decant. At the end of the decant cycle, determine the discharge rate set-point until the beginning of the next decant cycle. The CP-2000 will read and calculate:
 - (1) EQ basin water level
 - (2) Time until the next decant cycle
 - (3) EQ basin minimum water level at start of decant (set-point)
 - (4) Calculate the discharge rate between decants: Decant volume equal to (1) minus (3), multiplied by the EQ basin volume per foot of depth.

The decant flowrate equals the decant volume divided by time until next decant cycle (2). Prior to the next decant cycle, use this discharge rate as the flow rate setpoint to modulate the actuated control valve.

- (2) Mode 2: Influent Flow Matching. The objective of this mode is to use the equalization basin to match the effluent flow from the equalization basin to the average influent flowrate to the plant (as measured at the headworks). The discharge rate set point should be automatically calculated and based on the average influent flow over the last 4 hours.
- (3) Mode 3: Manual operation, operator-selected valve position. This mode provides the operator with a means to manually adjust the valve position using the SCADA system. This mode is primarily intended for testing and troubleshooting purposes.

- 4.4 High Level/Overflow Alarms. To alert the operator of a high-water event, the CP-2000 shall trigger an EQ basin high level alarm when the water level reaches the high-water level set point.

Additionally, an overflow alarm shall be also be triggered if the water level reaches the overflow level float switch as redundant safety measure.

- 4.5 Actuated Valve Control Valve. The specified valve actuator provides feedback to the CP-2000 to confirm valve position. The valve actuator also provides feedback to CP-2000 to indicate the selector switch position. The valve actuator has a remote/local/off selector switch. Separate discrete inputs for L-O-R in local and L-O-R in remote shall be provided. In the “remote” mode, the valve position is controlled automatically by the CP-2000 as described above. In the “local” mode, position switches on the actuator itself can be used to adjust the valve position. In the “off” mode, the actuator will not operate. The selector switch position feedback functions enable the operator to observe the valve operating mode from the main treatment plant control panel. The valve actuator also has various alarm and fault conditions that are relayed to the main treatment plant controller. At a minimum, the valve alarm points shall be as follows.
- (1) Valve fail to respond to desired position (feedback position not equal to desired position after a reasonable amount of time).
 - (2) Valve over-torque.
- 4.6 EQ Bain Flow Meter. The EQ basin flow meter is located in a channel immediately downstream of the EQ basin. The instrument is an ultrasonic open channel flow meter. This flow meter is not the main effluent flow meter that is to be used for reporting purposes. The main effluent flow meter is located at the chlorine contact chamber. The EQ basin flow meter shall be connected to the CP-2000 where the instantaneous and totalized flow shall be displayed. The data from the effluent flow meter shall also be used to control the EQ basin as described above. The SCADA system shall have a screen for the EQ basin that displays the instantaneous flow and the totalized flow as well as the current flow set point. Units for each of these parameters shall be displayed.

PART 5 CHLORINE CONTACT CHAMBER

The chlorine contact chamber receives flow from the Equalization Basin and the DAF Clarifier during the winter discharge season. During the summer storage season, the chlorine contact chamber is empty. Chlorine solution is added to the effluent in a manhole upstream of the contact chamber. The contact chamber provides the time needed for the chlorine to disinfect the effluent. The carrier water pump, effluent flow measurement weir, and a drain pump are located near the downstream end of the contact chamber. The carrier water feed pump is described below in the section on the dechlorination system.

- (1) Effluent Flow Measurement. The effluent flow measurement weir is fitted with an ultrasonic flow meter. The flow meter includes a local readout for instantaneous flow and total flow that is located at the contract chamber. These signals are transmitted to the DAF Building Main Plant PLC (CP-3000). The operator interface for the CP-3000 has a screen to display the following information.
 1. Instantaneous effluent flow in gallons per minute
 2. Total effluent flow in millions of gallons since commissioning
 3. Total effluent flow today in millions of gallons
 4. Total effluent flow yesterday in millions of gallons
 5. Total effluent flow this month in millions of gallons
 6. Total effluent flow last month in millions of gallons
- (2) Drain Pump. The drain pump is a small submersible pump that is controlled manually by operations staff. There is not instrumentation or monitoring associated with the drain pump.

PART 6 BLOWER BUILDING

The blower building is located south of the SBR tankage and includes two rooms. One room is an electrical/control room that includes electrical distribution gear, the automatic transfer switch for the generator, and the SBR control panel. The second room houses the blowers and the air control valves. This equipment is controlled by the SBR control panel. The system integrator shall coordinate with the manufacturer and the design team to determine the monitoring requirements for the blowers and the air control valves.

PART 7 DISSOLVED AIR FLOATATION (DAF) BUILDING

The DAF building includes the DAF clarifier and the associated chemical feed systems (i.e., polymer and flocculant), the high pressure air system, the onsite chlorine generation system, the chlorine injector pumps, and a tepid water safety shower and eyewash. The purpose of the DAF clarifier is to polish the effluent stored in the lagoon prior to blending with the SBR effluent for discharge. The polymer feed, flocculant feed, and high pressure air systems are all support systems for the DAF clarifier process. The purpose of the onsite chlorine generation system is to provide chlorine for disinfection purposes. The tepid water safety shower and eyewash are for operator safety. The building includes two rooms. One room is an electrical control room that includes the electrical distribution gear, the automatic transfer switch for the generator, the DAF motor control panel, the DAF PLC control panel, the Irrigation/DAF control panel (see below), and the Irrigation pump and DAF pump VFDs and motor controls. The second room houses all other DAF equipment, the onsite chlorine generation system, and the safety shower and eyewash.

- 7.1 DAF System. The DAF equipment is being supplied as a packaged system by Krofta Technologies. The DAF equipment package includes the tube flocculator skid, the DAF tank unit, the effluent turbidity skid, two coagulation pump skids, two polymer make down skids, the sludge transfer pump skid, two air compressor packages, a motor control panel, and a PLC control panel. All of this equipment is controlled by the DAF control system. The system integrator shall coordinate with the manufacturer and the design team to determine the appropriate monitoring requirements for the DAF equipment.
- 7.2 Onsite Chlorine Generation System. The onsite chlorine generation system consist includes a brine tank, the chlorine generator, a chlorine solution tank with a blower to vent hydrogen gas, a metering pump skid, and a hydrogen gas leakage detector. The chlorine generator is a proprietary equipment item that has an integrated control system. When the liquid level in the chlorine solution tank drops, the generator automatically starts and converts the brine solution to chlorine solution. Salt is added to the brine tank manually. The chlorine generator is a packaged product and the system integrator shall coordinate with the manufacturer and the design team to determine the appropriate monitoring requirements. At a minimum the water level in the chlorine solution tank shall be monitored by the SCADA system. The SCADA system shall have a low level tank setpoint that generates an alarm anytime the liquid level in the chlorine solution tank drops below this value. The chlorine generator status should also be monitored as well as any general alarms provided by the generator. The system includes a hydrogen gas leak detector. The alarm from this detector shall be monitored by SCADA for alarm callout.
- 7.3 Chlorine Injector Pumps. The Chlorine injector pumps pump chlorine solution from the chlorine solution tank to the injection points. There are two chlorine injection points and dedicated pumps for each injection point. During the winter discharge season, chlorine is injected into a manhole upstream of the chlorine contact chamber. During the summer irrigation season, chlorine is

injected into the irrigation forcemain pipe at the existing irrigation filter. A total of three injection pumps are provided with one being a backup for the other two pumps. In order to switch between the duty and backup pump, the pump skid is fitted with manual adjustment valves and this process is a manual process rather than an automatic process. All chlorine injection is flow paced. During the winter discharge season, the chlorine injection rate is paced using a signal from the effluent flow meter located at the end of the contact chamber. During the summer irrigation season, the injection rate is paced using the irrigation flow meter. During the winter months, discharge from the treatment plant is continuous and the chlorine pump can be started manually and paced automatically. During the summer irrigation season, the chlorine pump should start only when an irrigation pump is called to start. Once called to start, the summer chlorine pump will be paced automatically and stopped when the irrigation pumps stop. All three chlorine pumps shall be monitored as follows.

1. Metering Pump Status (on/off)
2. Metering Pump Dosing Rate
3. Chemical Metering Pump Speed
4. Chemical Metering Pump Fail alarm

- 7.4 Safety Shower and Eyewash System. A safety shower and eyewash are included in the chemical room. The safety shower and eyewash system includes a flow switch to alert City staff that the unit has been used. A signal from the flow switch is transmitted to the CP-3000. If the switch indicates flow to the safety shower and eyewash, an alarm callout is triggered.

PART 8 DECHLORINATION BUILDING

The dechlorination building houses the sulfur dioxide gas feed equipment. This equipment is used to inject sulfur dioxide gas into a carrier water stream. The carrier water is supplied by a carrier water pump located in the chlorine contact chamber. The carrier water containing sulfur dioxide is discharged into the chlorine contact chamber on the downstream side of the flow measurement weir. The purpose of this system is to remove any residual chlorine from the treated effluent prior to discharge to Beaver Creek. The system includes two gas cylinder scales, the sulfonator, the injector panel, a sulfur dioxide leak detection system, an automatic gas cylinder shutoff system, and the carrier water pump.

- 8.1 Sulfonator. Since the discharge rate from the plant can vary, the sulfur dioxide feed rate needs to be flow paced. Therefore, the sulfonator receives a signal from the effluent flow meter. The sulfonator has an internal control module that adjust the gas feed rate automatically in response to the effluent flow signal. The sulfonator shall be monitored for high and low vacuum alarm conditions as well as the current dosing rate.
- 8.2 Sulfur Leak Detection System. The sulfur dioxide gas sensor shall be trigger a leak alarm whenever gas is detected.
- 8.3 Gas Cylinder Scales. The sulfur dioxide cylinder scales will display the weight at a local indicator and shall be monitored remotely by the SCADA system. The operator interface for the

CP-3000 includes a screen to display the current weight, yesterday's weight, the weight the day before yesterday.

- 8.4 Carrier Water Pump Control. The carrier water pump is controlled using a variable frequency drive. The speed of the pump is controlled manually by the operations staff by selecting a pump speed at the CP-3000.
- 8.5 Carrier Water Pump Monitoring. The carrier water pump shall be monitored for a pump fail condition via a flow sensor located on the injector panel. The flow sensor shall trigger an alarm anytime the flow signal drops below an operator-selected low flow rate (initially set at 0.5 gpm).
- 8.6 Automatic Cylinder Shutoff System. This is a proprietary system consisting of actuators on each cylinder and a control panel. The system integrator shall coordinate with the manufacturer and the design team to determine the monitoring requirements for the cylinder shutoff system.

PART 9 IRRIGATION/DAF PUMP STATION

The irrigation/DAF pump station includes two sets of pumps. The three larger pumps are used to pump treated effluent to the summer irrigation reuse site. The two smaller set of pumps are used to pump water to the DAF clarifier. The control and monitoring of these will be addressed separately below. There are three irrigation pumps. Two of these are new and are installed on the east side of the old chlorine building. The third irrigation pump is an existing pump that is located on the south side of the old chlorine building. There are two DAF pumps that are located east of the old chlorine building. The City's system integrator will supply the control panel for all 5 pumps and the control panel and associated variable frequency drive and motor controls will be located in the DAF building control room. In addition to these five pumps, there is also a sixth pump that is currently used to irrigate a small irrigation site at the treatment plant site. This pump will be repurposed to serve as a flushing pump to flush out the sludge piping from the DAF system as described below.

- 9.1 Primary Irrigation Pump Station. At the present time, the City irrigates treated effluent during the summer irrigation season at the primary irrigation site south of the City that is equipped with a center pivot irrigation sprinkler manufactured by Reinke. The sprinkler system includes a control panel that provides a remote start/signal for the existing irrigation pump. The existing sprinkler control system and the irrigation pump are controlled by the proprietary control system manufactured by Reinke. As part of the treatment plant improvement project, the City's system integrator will need to replace this proprietary communication system with a system that is compatible with the City's existing SCADA system. This may require a new telemetry panel at the irrigation site. The existing irrigation pump operates at a constant speed and pressure that is matched to the demands of the irrigation sprinkler. In the future, the city plans to develop additional irrigation sites. With more than one irrigation site, the irrigation demands will change depending on how many sprinklers are in use. Therefore, the new pump station is designed to accommodate variable demands as follows.
 - 1. During normal operation, the operators will select a pressure set point for the irrigation pumps.
 - a. Recommended Nominal Pressure Set-point = 55 psi
 - 2. A remote start signal will be provided by the Reinke Sprinkler control system that is currently connected to the City's SCADA system. Upon receiving a start signal, the automatic control system will start a single irrigation pump and automatically adjust the pump speed to reach and maintain the pressure set point selected by the operators. There

are pressure transducers installed on the discharge piping for each of the new irrigation pumps. One of these is used as the primary pressure transducer for pump speed control and the other is a redundant pressure backup monitor. Should the primary pressure transducer fail and start reading inaccurately, it could cause the pumps to speed-up or slow-down in an unacceptable manner. Therefore, the control system shall monitor the backup pressure transducer and trigger an alarm and shut down the system if the backup pressure transducer reaches the low or high pressure setpoints. These two alarm pressure setpoints shall be operator adjustable.

3. When initially called to start, the lead pump will first run in a **pipeline fill phase** and then a **pressure phase** to reach and maintain the pressure set-point.
 - a. The pipeline fill phase will be adjustable for fill pressure set-point and runtime.
 - b. The default will be 5 minutes of runtime at 20 psi. Initial fill time at start-up and commissioning should be longer and at lower pressure.
 - c. Once the pipeline fill phase duration is complete the system will maintain the pressure phase set-point.
4. The control system is designed to prevent more than one pump from running at a time. This is a safety feature that is designed to prevent over pressurizing the system. One pump is sufficient to meet the demands of the existing irrigation sprinkler. In the future, when additional irrigation sites are developed, the control system may need to be reprogrammed to allow two pumps to operate simultaneously. However, initially two pumps are not needed, and the control system will not allow more than one pump to operate at a time.
5. The irrigation pump manufacturer sets limits on the minimum allowable flow through the pumps. This is known as the “minimum continuous sustained flow” and is **160 gallons per minute** for the specified pumps. If the irrigation flow rate drops below the minimum continuous sustained flow for more than about 5 seconds, the automatic control system will shutdown the system and trigger an alarm. The flow meter mounted near the existing irrigation filter provides the signal for this control function.
6. In order to prevent detect and manage any leak or break of the pump discharge piping or the irrigation forcemain, the control system monitors the discharge rate from the station and will shutdown the system and trigger an alarm anytime the pressure exceeds the high flow setpoint. This high flow setpoint shall be operator adjustable.
7. The control systems shall also monitor the system pressure and shut down the system and trigger an alarm anytime the system drops below the low pressure setpoint or exceeds the high pressure setpoint. The high and low pressure setpoints shall be operator adjustable.
8. When called to stop pumping by the Reinke sprinkler control system, the irrigation pump shall slowdown over a 20 second slow down period and then stop. The lead pump position shall then switch to the next pump in the sequence to ensure that each pump operates the same amount of time over the duration of the irrigation season.

- 9.2 Onsite Irrigation Pump/Sludge Pipe Flushing Pump. The pump used to irrigate effluent at the small onsite irrigation area located at the treatment plant will be re-purposed to flush the sludge piping from the DAF building to lagoon cell 1. This pump is located next to the existing irrigation pump. The new control system for the plant shall include the ability to manually start and stop this pump and the set this pump to run on timer settings. The City will most likely use operate this pump manually to flush the sludge pipe. However, the City would also like the ability to automatically start this pump to flush the sludge piping occasionally. This would require running this pump for 10-30 minutes once per week. The discharge piping for this pump is equipped with low and high pressure switches that stop the pump if the pressures exceed the

setpoints. This system shall remain in place. The power and control to these pumps has been moved to the new DAF Building MCC (MCC-3000), which will operate these pumps on VFDs.

9.3 DAF Pump Station. The purpose of the DAF pump station is pump water into the DAF clarifier system. Two DAF pumps are provided. One DAF pump is sufficient to meet system demands. The second DAF pump is a redundant backup. The DAF pumps shall have two control modes.

- (1) Normal Mode. When in normal mode, the DAF pumps will be pump water to the tube flocculator located inside the DAF building. The tube flocculator is equipped with a magnetic flow meter. The signal from this flow meter shall be used to control the DAF pump speed. The DAF pump shall be started manually or from a remote signal from the DAF system control panel. The DAF pump speed shall be automatically adjusted to maintain the operator selected flowrate to the DAF system. The DAF flow meter located on the tube flocculator shall be used for this purpose. This will require the City's integrator to coordinate with the DAF equipment supplier to obtain the analog flow signal from the DAF flow meter. The DAF pump control system include high and low level alarm/shutdown setpoints that are operator adjustable similar to the system described above for the irrigation pump station. The DAF pumps shall alternate lead and lag position anytime the pumps are stopped or if more than one week elapses. The DAF pump manufacturer sets limits on the minimum allowable flow through the pumps. This is known as the "minimum continuous sustained flow" and is **100 gallons per minute** for the specified pumps. The control system shall not allow the operators to select a pump flowrate that is less than 100 gpm.
- (2) Bypass Mode. During certain circumstances, the DAF treatment system can be bypassed and the DAF pumps can pump directly to the chlorine contact chamber. The DAF discharge piping includes buried valves and cross-over piping to permit the operators to use the DAF pumps to bypass the DAF treatment process and pump directly to the chlorine contact chamber. Under this operation mode, water will no longer flow through the DAF flow meter. Therefore, the control system shall include an operator-selected pump speed for the Bypass Mode. The operations staff can use the effluent flow meter located on the downstream end of the chlorine contact chamber to determine the appropriate DAF pump speed in Bypass Mode. In the Bypass Mode, the DAF pumps shall alternate lead and lag position anytime the pumps are stopped or if more than one week elapses.

9.4 Primary Irrigation Flow Meter. The irrigation flow meter is located on the inlet pipe to the existing irrigation flow meter near the irrigation pump station. The flow meter is the primary device used to track the quantities of water that is being irrigated. The flow meter includes a local readout for instantaneous flow and total flow located in the DAF building. These signals are transmitted to the **CP-3000**. The operator interface for the **CP-3000** has a screen to display the following information.

- (1) Instantaneous irrigation flow in gallons per minute
- (2) Total irrigation flow in millions of gallons since commissioning
- (3) Total irrigation flow today in millions of gallons
- (4) Total irrigation flow yesterday in millions of gallons
- (5) Total irrigation flow this month in millions of gallons
- (6) Total irrigation flow last month in millions of gallons

9.5 DAF Flow Meter. The DAF low meter is located on the tube flocculator in the DAF building. This flow meter is part of the DAF equipment package and is monitored by the DAF control system. The flow signals from this flow meter are transmitted to the CP-3000. The operator interface for the **CP-3000** has a screen to display the following information.

- (1) Instantaneous DAF flow in gallons per minute

- (2) Total DAF flow in millions of gallons since commissioning
- (3) Total DAF flow today in millions of gallons
- (4) Total DAF flow yesterday in millions of gallons
- (5) Total DAF flow this month in millions of gallons
- (6) Total DAF flow last month in millions of gallons

PART 10 PRIMARY EFFLUENT REUSE SITE

During the summer months, the City primarily disposes of treated effluent at the main irrigation site located south of the City. The existing facilities at this site include a center pivot irrigation system and an associated control system manufactured by Reinke Irrigation. As described above the center pivot control system, currently provides a remote start signal for the existing irrigation pump. The communication system is a proprietary system manufactured by Reinke Irrigation that is not currently integrated into the City's SCADA system. As part of the treatment plant project, the City would like to integrate the sprinkler control system into the SCADA system. This may require the installation of a new telemetry panel at the irrigation site.

PART 11 ONSITE EFFLUENT REUSE SITE

A small area around the SBRs are used to dispose of treated effluent during the summer irrigation season. This system shall remain in place. However, it is a relatively simple system that consists of a dedicated above (described above), some buried irrigation piping, and a few sprinklers. This system is largely operated in a manual fashion. There are two pressure switches that shut down the pump if a low or high pressure is detected. But, there is no other instrumentation or automatic control needed for this system.

PART 12 FACULTATIVE SLUDGE STORAGE LAGOON

The Facultative Sludge storage lagoon provide long-term storage and treatment of the waste sludge from the SBR process and from the DAF clarifier. The waste sludge pumps located in each SBR discharge to sludge storage lagoon as does the solids pump from the DAF system. The solids from these sources settles out in the lagoon and the clear liquid from the lagoon can either be routed to the plant pump station or to the effluent storage lagoons. All operations associated with the sludge storage lagoon are manual and there is no instrumentation or monitoring requirements associated with the sludge storage lagoon.

PART 13 EFFLUENT STORAGE LAGOONS

From May 1 through October 31 of each year, the City is not permitted to discharge treated effluent to Beaver Creek. Therefore, all effluent from the SBR is routed to the effluent storage lagoons. During the summer irrigation season, effluent stored in the lagoons is pumped to the irrigation sites using the irrigation pump station. During the winter discharge season (November 1 – April 30) the DAF pump station is used to pump lagoon effluent to the DAF clarifier for polishing prior to discharge. Flow between the lagoons can be controlled by a relatively simple system of manual control valves. All operations associated with the effluent storage lagoons are manual and there is no instrumentation or monitoring requirements associated with the effluent storage lagoons.

PART 14 PLANT PUMP STATION

The various tank drains and wastewater sources at the plant are routed to the plant pump station where the submersible pumps pump the water to the headworks for treatment. The plant pump station is a simple duplex station with level controls that start and stop the pumps. The control panel for the station shall be provided by the system integrator and is to be located in a small fiberglass enclosure next to the pump station. The plant pump station includes a wet well, two submersible pumps, a valve vault, and a fiberglass control shelter. A flow meter is located on the pump station forcemain at the headworks. The monitoring requirements for the flow meter are described above in the headworks section of this document. The plant pump station control panel shall be connected to the **Blower Building Main Plant PLC (CP-2000)** for remote monitoring. The operator interface shall display the level in the wet well, the pump status, and any alarm conditions. The level controls consist of a primary level transducer and redundant level control floats. The control system shall enable the operations staff to set the following level setpoints: (1) low level alarm, (2) lead pump off, (3) lag pump off, (4) lead pump on, (5) lag pump on, (6) high level alarm. A redundant level control system is included that includes the following float switches: (1) all pumps off, (2) all pumps on/redundant high-level alarm. The redundant control float switches are located above the normal operating levels in the wet well. Therefore, should the primary level control system fail, the water level in the wet well will rise and the redundant level control floats will take control of the station. The wet well is also equipped with an overflow float switch to provide an overflow alarm. The pumps are supplied with thermal overload monitoring switches and leak detector switches. An alarm condition shall be triggered if either of these switches indicate a problem condition.

PART 15 COMPLIANCE MANHOLE

The compliance manhole receives water from the chlorine contact chamber during the winter discharge season. The effluent sampler is used to collect time based or flow proportional composite samples. Therefore, the signal from the effluent flow meter is connected to the sampler. The effluent sampler is not equipped with a pH or temperature probe. The City will collect pH and temperature data using their hand-held equipment.

PART 16 BACKUP POWER SYSTEM

Each site (SBR Building and DAF Building) will have their own generator sets tied to an automatic transfer switch (ATS) for backup power in the event of loss of utility power. The generators include a fuel level sensor to detect low fuel. Each generator's inputs and outputs are sent to the building main control panel (CP-2000 and CP-3000, respectively).

S

END OF SUPPLEMENT

DIVISION 14

CONVEYING SYSTEMS

SECTION 14302
FREE STANDING JIB CRANE

PART 1: GENERAL

1.1 SCOPE

- a. This section includes the furnishing and installing the free standing jib crane(s) specified or shown on the drawings, complete with all appurtenances and accessories specified or required to provide a complete operational system.
- b. All installations shall be complete and comply with manufacturer's erection details and applicable OSHA regulations.
- c. All work performed under this section shall be in accordance with all approved trade practices and manufacturers' recommendations, including provisions for insulation between dissimilar metals where applicable.
- d. A representative of the manufacturer of the pumps shall provide start-up & testing services, and training in the operation and maintenance of the equipment (ie. training of the Owner's personnel).

1.2 SUBMITTALS

- a. At the front of the submittal package, the Contractor shall clearly indicate and list all exceptions, variances or substitutions from the requirements in the specifications or on the Drawings (*any proposed changes, substitutions or differences of any kind*), as well as marking these on the applicable submittal page(s).
- b. Submittals shall be in accordance with the requirements of these Contract Documents and shall include:
 - 1) American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (*listing each item, and the location of manufacturer for each item*).
 - a) Per EPA guidelines dated 3/20/2014, cranes, motors, gear reducers & associated drives are excluded from this requirement, "*including their appurtenances necessary for their intended use and operation*".
 - 2) Submittals for Review
 - a) Descriptive literature, bulletins or other data describing the system equipment.
 - b) Complete list of equipment, appurtenances and all options included, complete, with manufacturer's name and model number.
 - c) General arrangement and dimension drawings.

- d) Sectional assembly drawings.
 - e) Materials of construction.
 - f) Location of local service facility as specified.
 - g) Information on capacity labels and signs as specified.
- 3) Submittals for Record (for inclusion in the O&M manuals).
- a) Manufacturer's operations & maintenance instructions.
 - b) Manufacturer's and installer's installation certification letters.
 - c) Startup, calibration and full load field test report.
 - d) Copy of manufacturer's warranty for specific equipment installed.
- 4) Installation Certifications. At the completion of the crane installation, the following certifications shall be submitted as a minimum and included in the front of the O&M manuals.
- a) Certification letter signed by the manufacturer's representative including the following as a minimum:
 - (1) Statement that all required installation manuals were provided to the installer with the crane(s).
 - (2) Statement that the installation is as specified and is acceptable to the manufacturer.
 - (3) Date and time that full load field testing was completed on the installed crane/hoist assembly, and a brief summary of the test results and measured boom deflection.
 - (4) Statement that the warranty and/or guarantee will be in full effect during the warranty period with no qualifications or reservations.
 - b) Certification letter signed by the crane installer stating the following as a minimum:
 - (1) The installation and operations manuals were received with the crane and appurtenances.
 - (2) The installer has read the manufacturer's recommended installation procedures.
 - (3) The crane, hoist and appurtenances were installed in strict conformance with the specification requirements and the manufacturer's recommended installation procedures. Any variances shall be noted.

- (4) The crane base was leveled and plumbed as required before grouting.
- (5) The plumbness of the mast and the levelness of the boom was checked after the crane was erected and subject to the full load field test.

1.3 CODES AND STANDARDS

- a. The crane system shall meet or exceed ANSI (American National Standards Institute) B30. 11 specifications, as they pertain to Free Standing Jib Cranes. The terms used in this specification are in accord with the definitions prepared by ASME/ANSI B30.1 1. OSHA (Occupational Safety and Health Administration) specification 1910.179, as it applies to jib cranes, shall be adhered to.

1.4 WARRANTY

- a. In addition to the general guarantee required for the project, the crane manufacturer shall furnish the Owner with a written 10 year warranty to cover the jib crane and components against defects in workmanship and material, as well as a 10 year warranty for the trolley/hoist assembly.

PART 2: PRODUCTS

2.1 GENERAL

- a. Unit Responsibility. The entire jib crane system, including the trolley & electric chain hoist assembly, shall be provided by a single supplier (ie. single source responsibility). However, this shall not relieve the General Contractor's responsibility for coordinating, installing and performing his complete portion of the work.
- b. Each jib crane installation shall consist of a complete and operational jib crane system as specified or shown on the drawings, including mast, boom, crane base, chain hoist with hand trolley, hook assemblies as required for connection to the equipment for which the crane is to be used.
- c. The jib crane shall be provided with an I-beam boom capable of being rotated smoothly while under full rated load.
- d. Materials and Assembly. All materials provided shall be new. The crane system shall be constructed of structural steel, in accord with current AISC (American Institute of Steel Construction) and ASTM (American Society for Testing and Materials) A-36 specifications minimum. The crane and all components will be fabricated in the U.S.A. and/or Canada.
- e. Welding. All welding performed on the cranes will conform to the current recommended practices of the AWS (American Welding Society) D14.1 specifications. Welders will have completed a formal certification program for AWS D14.1.

2.2 ANCHOR BOLTS

- a. Unless otherwise shown on the drawings, anchor bolts shall be cast-in-place with a minimum embed as shown on the drawings, and shall be 304 stainless steel.
- b. The diameter, length and any bend dimensions of anchors shall be as shown on the drawings or as recommended by the equipment or machinery manufacturer, whichever is more stringent. In no case shall anchor bolts be more than 1/8-inch smaller than the anchor bolt holes provided by the manufacturer in the equipment or machinery.
- c. A minimum of two (2) nuts and one washer (of the same material as the anchor bolt) shall be furnished with each anchor bolt for fastening the crane to the mounting pedestal or slab.
- d. A minimum of one (1) leveling nut and one washer (of the same material as the anchor bolt) shall be furnished with each anchor bolt for leveling the crane mast prior to grouting.

2.3 JIB CRANE

a. General Design

- 1) The free standing jib crane shall consist of a stationary mast (pillar), about which a boom and box-style head rotate. The crane shall be Free Standing (ie. the floor foundation shall be the crane's only means of support).
- 2) The crane shall provide coverage for a circular work area about the mast, and be capable of 360° of continuous rotation prior to installation of rotational stops.
- 3) The crane shall be designed for manual rotation. The crane's boom shall not drift when at rest, yet shall rotate easily under full load when manually pushed or pulled.
- 4) Rotational Stops. Steel rotation stops shall be provided to limit the crane's rotation angle as shown on the drawings or directed by the Owner (2 typical required).
 - a) If the rotational stops are field welded, the welding shall be by a certified welder acceptable to the crane manufacturer's representative (*with no limitations on the warranty*), and restoration of the galvanized coating at welds is acceptable to the manufacturer's representative.
- 5) The crane, trolley/hoist assembly, and all components and appurtenances shall be provided by a single supplier for unit responsibility. The supplier shall have a certified service facility located within 100 miles of the crane location.

b. Capacity and Design Loads

- 1) The crane shall be designed to withstand the dead load (caused by the weight of the crane and components themselves), the live load and hoist load, and the inertia forces caused by movement of the crane, components, and loads during standard operation.

- 2) The design load for stress calculations shall be based upon the capacity plus 15% for the weight of the hoist and trolley and an additional 25% for impact (capacity x 1.4). Design load for deflection calculations shall be based upon the capacity plus 15% for the weight of the hoist and trolley (capacity x 1.15).
- 3) Capacity Labels. The rated load capacity of each crane shall be clearly labeled on each crane using a label size easily read from the floor level and/or loading position.

c. Mounting Base

- 1) The crane shall stand by means of the mast being welded to a hexagonal base plate. The crane shall feature full web gussets plates, welded to the mast and base plate, about the mast for stability and reinforcement. The base plate shall feature the number of holes for anchor bolts to anchor the crane into the recommended foundation as specified or noted on the drawings.
- 2) Any design with open gussets (bars that support only the outside of the base plate), or any base plates made from rings, are not be acceptable due to their tendency to warp.
- 3) The crane base shall be welded steel construction with a factory applied hot dip galvanized finish.

d. Mast Assembly

- 1) The mast shall consist of a round structural steel pipe. Masts shall be plumb and straight, and will be perpendicular to the boom.
- 2) The mast will remain stationary during rotation and use of the crane.

e. Boom

- 1) The boom shall consist of a standard structural steel I-beam or wide flange, and shall be reinforced with a cap channel for lateral stability. The boom shall bolt to the head assembly. Means shall be provided to allow for the slight horizontal adjustment of the boom so that it can be erected and maintained level.
- 2) The boom shall be level and horizontal (within the specified deflection limits), and shall permit a hoist trolley to ride upon its flat flange track. Trolley stops shall be utilized to prevent the hoist trolley from falling off the boom or contacting any obstruction.
- 3) The crane's deflection at the end of the boom shall not exceed 1/150 of the crane's span under full rated load.

f. Head Assembly

- 1) The head assembly shall consist of two side plates, a top frame weldment, a bottom head channel, a trunnion roller support frame, and a back safety channel, and shall provide for bottom entry electrification.

- 2) A retaining pin shall be utilized in the head assembly to help protect against head dislodgment.
 - 3) Rotation of the crane shall be accomplished via full-face contact trunnion rollers working in conjunction with a top pivot bearing assembly with a heavy-duty tapered roller bearing. The rollers shall not carve into the mast during rotation, and a wear ring shall not be required. Any crane with a wear ring about the mast will not be acceptable.
- g. Galvanizing. All crane components shall be hot dip galvanized after fabrication. Painting after galvanizing is not required.
- h. Trolley & Chain Hoist Assembly
- 1) The jib crane shall be provided with a trolley, under which is mounted a manual chain hoist consisting of an aluminum alloy frame and gear case cover what houses an automatic load brake and gear train. Trolley and chain hoist configuration shall be as shown on the drawings and as specified herein.
 - 2) Trolley
 - a) Rigid mount trolleys shall be designed especially for use with lug or hook suspended hoists as specified or as noted on the drawings. Where lug mounted trolleys are specified, the trolleys shall attach directly to lug brackets on the hoists, thereby forming integral trolley-hoist combinations, offering close headroom dimensions.
 - b) Trolley shall be designed specifically for use with the specified lug or hook mounted electric chain hoist. The wheels shall be heat treated forged steel with dual tread design for operation on either “S” or wide flange beams. Trolley wheels shall have permanently lubricated, sealed precision ball bearings for easy travel under full load, and the trolley shall be provide with heavy gauge steel side plates to provide a heavy duty unit.
 - 3) Chain Hoist
 - a) Hoists shall be provided with hook or lug suspension from the trolley as specified, or as noted or shown on the drawings. The capacity of the hoist shall match the capacity of the crane.
 - b) Chain hoist shall be manually driven with a drive chain loop.
 - c) Hoists shall have a Weston type mechanical load brake located in the gear case. The brake shall have the capability of holding rated load in event of a failure of the other brake system.
 - d) Load sprocket with a full floating chain guide that assures proper engagement of chain on sprocket. Hoist shall be provided with link chain, with the chain length as required for the lift required for the

locations and equipment shown on the drawings or specified herein, but not be less than 10 feet.

- e) Chain Container.
 - (1) Hoist shall be provided with a chain container to eliminate hanging tail chains when the hook is in the full retracted position, and shall accept chain in a way that will not kink or twist the chain.
 - (2) The chain container shall be designed so that it does not hold water. Plugs shall be removed from any drain holes provided.
- f) The lower block shall be provided with a 360° rotating hook riding on thrust bearings. The hook shall be provided with a spring loaded latch. The hook eye shall be sized to accommodate the lift points on the equipment for which the crane is installed.
- g) The hoist frame and housing shall be constructed from lightweight, rugged aluminum alloy, with the housing precision machined for accurate gear and bearing alignment. All gearing shall be totally enclosed, oil-bath lubricated for long life.
- 4) Trolley/Hoist Components Corrosion Resistant Coatings & Features. The trolley/hoist unit shall be provided with corrosion resistant options including powder coat finish, weatherproofing, hook & lower block, zinc plated chain, etc.
- i. Jib crane and trolley/hoist assembly shall be Gobel Free Standing Jib Crane (FS300-8-W6) with push trolley and Yale LH2 manual chain hoist, as provided by Milwaukee Crane & Equipment Co., Tigard OR, or approved equal. Crane and hoist shall be rated for a safe working load of ½ ton. Boom length and lift height shall be as shown on the drawings.

PART 3: EXECUTION

3.1 INSTALLATION

- a. The crane and associated hoisting equipment shall be erected in accordance with the manufacturer's recommendations and drawing details. Drilled in anchor bolts are not acceptable substitutes for the cast-in-place anchor bolts specified.

3.2 INITIAL LUBRICATION

- a. Initial lubrication required for startup and field test operation shall be furnished and applied in accordance with the manufacturer's recommendations.

3.3 INSPECTION, START-UP AND TESTING

- a. The Contractor shall pay for the manufacturer's representative to perform field inspection, field start-up, field load testing and training services (ie. training of the Owner's personnel). The manufacturer's representative shall be experienced in the operation and maintenance of the equipment.

- b. The manufacturer's representative shall check the installation and supervise start-up and testing of the equipment as specified. He shall certify that the installation is correct and that the equipment has operated satisfactorily, all lubrication is satisfactory and shall provide the specified certifications for inclusion in the O&M Manuals.
- c. For hoists installed in outdoor locations or locations subject to moisture, the Contractor and manufacturer's representative shall verify that any drain plug in chain containers are removed, to avoid any buildup of water in the container.
- d. After installation is completed, all equipment shall be tested in accordance with the provisions of the ANSI Safety Standards for Cranes and Hoists. Field testing shall include (*but not be limited to*) the following, and shall be witnessed by the Owner's Representative.
 - 1) Field testing to the 125% of the full rated capacity of the crane (*as measured at the full extension end of the boom*), including measurement of boom deflection under full rated load. The crane supplier or Contractor shall arrange for a test weight to be provided equal to 125% of the full load capacity of the crane, (*weight to be verified and certified in writing, acceptable to the manufacturer's representative*), for use during the startup and load tests.
 - 2) The crane shall be rotated under full load to the extent allowed by any installed stops, and shall rotate freely and smoothly.
 - 3) The hoist carriage shall be moved under full load to the extent allowed by any installed stops, and shall move freely and smoothly.
- e. Training.
 - 1) After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the Owner's personnel in the proper operation and maintenance of the equipment, prior to placing the system in permanent operation and service.
 - 2) This shall be in addition to the startup trip outlined above, and shall include a minimum of one trip on a day and time acceptable to the Owner.

PART 4: SPECIAL PROVISIONS

None.

DIVISION 15

MECHANICAL

**SECTION 15000
MECHANICAL, GENERAL**

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

- a. This section pertains to mechanical equipment supplied in this contract.

1.2 SUBMITTALS

- a. Complete layout drawings of mechanical equipment shall be provided. Layout drawings shall consist of plan and section views of areas containing mechanical equipment clearly showing pipe, fittings, valves, pipe hangers and supports, duct, and mechanical equipment and related appurtenances actually submitted and approved. The mechanical drawings do not show complete details of building construction. The Contractor shall check actual conditions and shall refer to mechanical and electrical drawings. Rerouting of pipe and duct from that shown on construction drawings will be permitted only as reviewed by the Engineer on submitted shop drawings due to interferences; types of material and equipment submitted and approved that are different from those originally shown on drawings and/or specified; Contractor's convenience for construction that does not compromise functional intent; etc. Layout drawings shall be completely dimensioned. Drawings shall be reviewed by Engineer before the applicable portion of mechanical work is performed. Submit shop drawings in accordance with Section 01300, Submittals.

PART 2: PRODUCTS

2.1 FLANGES AND PIPE THREADS

- a. Unless otherwise noted, flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B2.1, Taper Pipe Thread.

2.2 GUARDS

- a. All exposed moving parts shall be provided with guards in accordance with the requirements of the State Industrial Safety Code. Guards shall be fabricated of 12-gage steel and expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts.

2.3 BEARINGS

- a. Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller antifriction type of standard manufacture. Bearings shall be conservatively designed to withstand stresses of the service specified. Each bearing, except when otherwise noted, shall be rated in accordance with the latest revisions of Methods of Evaluating Load Ratings of Ball and Roller Bearings for one of the following classes of B-10 rating life: Class M1, 8,000 hours of operation; Class M2, 20,000 hours of

operation; Class M3, 50,000 hours of operation; Class M4, 100,000 hours of operation. Bearings shall be not less than Class M3 unless otherwise noted.

- b. Grease lubricated bearings, except those specified to be factory lubricated for life, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be the standard hydraulic type.
- c. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 40 degrees C and shall be equipped with a filler pipe and an external level gage.
- d. During transportation bearings shall be suitably blocked or otherwise suitably protected to avoid work hardening or "Brinelling" damage from vibration. Bearings shall be separately packed if necessary to comply with this requirement.

2.4 SHAFT COUPLINGS

- a. General: Shaft couplings for direct connected electric motor driven equipment 1/2-horsepower or larger shall be Type I or Type II as specified herein. Type I couplings shall be utilized for all reversing drives, positive displacement pumps or high torque loads such as conveyor belts. Type II couplings shall be employed on all other drives
- b. Where requirements of the equipment dictate specialized features, the manufacturer may substitute the coupling normally supplied for the service. Couplings shall be nonlubricated type designed for not less than 50,000 hours operating life. Coupling sizes shall be as recommended by the manufacturer for the specific application, considering horsepower, speed of rotation, and type of service. The use of couplings as specified herein shall not relieve the Contractor of his responsibility for precision alignment of all driver-driven units.
- c. Type I couplings: positive displacement pumps and reversing equipment or equipment where sudden torque reversals may be expected shall be connected to their drivers by flexible couplings which can accommodate angular misalignment, parallel misalignment, and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a built-up elastic member comprised of synthetic rubber, duck and wire reinforcement with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub fit. There shall be no metal-to-metal contact between the driver and driven unit.
- d. Type II couplings shall be employed on normal torque, nonreversing applications. Type II couplings shall be of the pin and preloaded neoprene cylinder type, designed to accommodate shock loading, vibration, and shaft misalignment or offset. Stub shafts shall be connected through collar or round flanges, firmly keyed to their shafts, to neoprene cylinders held to individual flanges by through pins. Couplings with cylinders pinned to both coupling flanges will not be acceptable

2.5 ELECTRICAL DEVICES

- a. All electrical motors, starters, control panels and other electrical devices furnished with mechanical system shall be UL labeled or furnished with other certification satisfactory to the Administrative Authority in accordance with the current applicable provisions of the W. In addition, electrical components shall comply with Division 16 of these specifications. See diagrams on electrical plans.

2.6 IDENTIFICATION

- a. Piping: Label piping, listed below, for identification. Apply labels at each valve or cock, at each side of each partition or floor through which the pipes pass, at each connection to equipment or mechanical device, and elsewhere at intervals of not more than 25 feet. Letters shall be over painted background color as shown below. Included direction arrow on applicable systems. Minimum length of color field and height of letters shall be as follows:

Outside Diameter of Pipe or Covering	Minimum Length of Color Field	Minimum Height of Letters
3/4 Inch to 1 Inch	8 Inch	½ Inch
1-1/4 Inch to 2 Inch	8 Inch	¾ Inch
2-1/2 Inch and Lager	12 Inch	1 Inch – 1-1/4 Inch

- b. Locate identifying markings so that they are visible from the floor. Color filed shall be in accordance with ANSI 13.1 and as approved by Engineer. For piping concealed above suspended ceilings, apply labels as specified above, except do the work before the ceiling is erected. Labels shall be plastic snap-on type as manufactured by Brady, or equal.
- c. Equipment and control devices: All equipment and associated control devices (both local and remote) such as thermostats, motor starters, disconnect switched, and the like, shall have plastic black and white lamoid labels, similar to the labels for the existing equipment, permanently affixed. Labels shall have generic name of item to which it is affixed followed by name or equipment number of item to which it is affixed to item controlled, ass applicable.

Examples: "Disconnect switch - EF-1"

"Thermostat - HV-1"

"Exhaust Fan - EF-1"

- d. Submit samples for Engineer review.

PART 3: EXECUTION

3.1 EQUIPMENT INSTALLATION

- a. Belt driven equipment: Mount with motors on common steel base with adjustable motor mounts.
- b. Locate and install sleeves, inserts, and supports as required at proper stage of construction.
- c. Install equipment so nameplates are visible.
- d. Basis for equipment and material installation is the published recommendations of manufacturer. Submit such recommendations for review.

3.2 SPARE PARTS STORAGE AND MARKING

- a. Spare parts shall be wrapped in weatherproof material and packed in a painted wooden box with a hinged cover and hasp lock. The box shall be clearly labeled on the front and top as to its contents. No box shall weigh more than 150 pounds when full.

3.3 LUBRICANTS

- a. The Contractor shall furnish mechanical equipment with supply and relief lubricant fittings and with its proper supply of correct lubricant for starting, testing and adjustment. The Contractor shall provide the Engineer with 5 copies of a list showing the proper lubricants for each item of mechanical equipment.
- b. Unless otherwise noted, grease lubrication fittings shall be the standard hydraulic type.
- c. For consistency throughout the facility oil products shall be manufactured by the Standard Oil Company of California.

3.4 STORAGE

- a. Equipment before and after delivery to the job site prior to its incorporation into the work shall be stored in a warm, dry, ventilated enclosure which shall afford complete protection against the elements and ensure that cleaned surfaces remain cleaned. Bearing capsules and housing shall be filled with fresh lubricant. Piping connections shall be plugged, blind flanged or capped to prevent the entrance of foreign objects and space heaters in control panels shall be connected to a suitable power source.

3.5 TESTING BUILDING SYSTEMS

- a. Contractor shall notify Engineer at least one week prior to testing. Provide tests specified. Provide test equipment including test pumps, gages, instruments, and other equipment required. Pressure gages used shall be graduated in increments suitable for magnitude of test pressures specified and shall have range of approximately twice test pressure. Use only gages and instruments recently calibrated.

- b. Where testing is specified, completed installation shall comply with designated requirements. Provide replacement materials as may be required to accomplish this compliance.
- c. Piping
 - 1) Remove from system, during testing, equipment which would be damaged by test pressure. Replace removed equipment after testing. Systems may be tested in sections as work progresses; however, any previously tested portion shall become a part of any later test of composite system. Correct leaks by remaking joints with new material; makeshift remedies will not be permitted. Test time will be accrued only while full test pressure is applied to system.
 - 2) Do testing before backfilling, concealing, insulating, or painting.
 - 3) Tolerance shall be no pressure drop, except that due to temperature change or as specified in test procedure. Perform tests in accordance with schedule as outlined in section 15060.
- d. Valves
 - 1) Test valve bonnets for tightness. Test operate valves from closed-to-open-to-closed position while valve is under piping test pressure.
 - 2) Test automatic valves by actuating from fully open to fully closed.
 - 3) Piping Specialties
 - 4) Test thermometers and pressure gages for accurate indication.
 - 5) Test all other piping specialties for proper operation.
 - 6) Hangers and supports: With system in normal operation, test hangers, supports, and rods to ensure they are plumb and supporting proper share of load. Additionally support, as required, systems and equipment that sway, crawl, or vibrate.
 - 7) Other materials and equipment: Test other materials and equipment as specified, as recommended by equipment manufacturer, or directed to assure they are complete, operable, and ready for use.

3.6 CLEANING

- a. During progress of work, keep Premises reasonably free of debris, cuttings, and waste material. Upon completion of work, and at other times as directed, remove such debris from premises.
- b. Clean equipment and materials. Remove foreign materials including dirt, grease, splashed paint, and plaster. Restore to original condition any damaged finish.

- c. Clean, by flushing, interior of water piping after pressure testing. Upon completion of flushing, completely drain system at all low points; remove, clean, and replace strainer baskets and refill systems.
- d. Potable water systems: After flushing, draining, and refilling, sterilize the potable water system in accordance with requirements of Section 15041.

3.7 START-UP PROCEDURES

- a. General:
 - 1) Provide material and labor required to perform start-up of each respective item of equipment and system prior to beginning of test, adjust and balance procedures. Provide information and assistance required, cooperate with test, adjust and balance services.
- b. Comply strictly with manufacturer's specified procedures in starting up mechanical equipment.
- c. Bearings:
 - 1) Inspect for cleanliness, clean and remove foreign materials.
 - 2) Verify alignment.
 - 3) Replace defective bearings, and those which run rough or noisy.
 - 4) Lubricate as necessary, and in accord with manufacturer's recommendations.
- d. Drives:
 - 1) Adjust tension in V-belt drives, and adjust varipitch sheaves and drives for proper equipment speed.
 - 2) Adjust drives for alignment of sheaves and V-belts.
 - 3) Clean, remove foreign materials before starting operation.
- e. Motors:
 - 1) Check each motor for amperage comparison to nameplate value.
 - 2) Correct conditions which produce excessive current flow, and which exist due to equipment malfunction.
 - 3) Check for proper rotation before running equipment.

f. Pumps:

- 1) Check mechanical seals for cleanliness and adjustment before running pump.
- 2) Inspect shaft sleeves for scoring.
- 3) Inspect mechanical faces, chambers, and seal rings, replace if defective.
- 4) Verify that piping system is free of dirt and scale before circulating liquid through the pump.

g. Control Valves:

- 1) Inspect both hand operated and automatic control valves, clean bonnets and stems.
- 2) Tighten packing glands to assure no leakage, but permit valve stem to operate without galling.
- 3) Replace packing in valves to retain minimum adjustment after system is judged complete.
- 4) Replace packing on any valve which continues to leak.
- 5) Remove and repair bonnets which leak.
- 6) Coat packing gland threads and valve stem with a surface preparation of "Moly-Cote" or "Fel-Pro", after cleaning.
- 7) Verify that control valve seats are free from foreign material, and are properly positioned for intended service.
- 8) Tighten flanges and couplings after system has been placed in operation.
- 9) Replace gaskets which show any sign of leakage after tightening.
- 10) Inspect screwed and welded joints for leakage.
- 11) Promptly remake each joint which appears to be faulty, do not wait for rust to form.
- 12) Clean threads on both parts, apply compound and remake joints.
- 13) Cut out welded joint and replace with new section of pipe and new couplings.
- 14) After system has been placed in operation, clean strainers, dirt pockets, orifices, valve seats and headers in fluid system, to assure system is free of foreign materials.

- 15) Remove rust, scale and foreign materials from equipment and renew any defaced surfaces.
- 16) Inspect fan wheels for clearance and balance.
- 17) Provide factory-authorized personnel for adjustment when needed.
- 18) Check each electrical control circuit to assure that operation complies with specifications and requirements to provide desired performance.
- 19) Inspect each pressure gage and thermometer for calibration.
- 20) Replace item which are defaced, broken, or which read incorrectly.
- 21) Repair damaged insulation.
- 22) Vent gases trapped in any part of system.
- 23) Verify that liquids are drained from all parts of gas or air system .
- 24) Check piping for leaks at every joint, and at every connection, using "Leak-Tek" or other approved compound.

3.8 CONTINUING ADJUSTMENTS

- a. Provide such periodic continuing adjustment services as necessary to insure proper functioning of mechanical system after occupancy of the project, and for a period of one year after Date of Substantial Completion.

**SECTION 15060
PIPING SYSTEMS**

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

- a. The work covered by this section consists of piping systems. The systems shall include piping, fittings, hangers, valves, couplings and connections to equipment.

1.2 GENERAL

- a. Contract drawings: The contract drawings indicate the general design, arrangement and extent of piping systems. It is desired that the indicated positions be followed as closely as possible. Do not scale drawings for roughing in measurements nor use as shop drawings. Prepare shop drawings per Paragraph 1.3, Submittals, herein. The exact location of the various items is subject to building construction, and the actual materials and equipment furnished by the Contractor. The Contractor shall verify the location of items furnished, installed or connected to by him. Coordinate work with other specification divisions.
 - 1) Piping systems shall be located from dimensions given on drawings or implied locations shall be determined at the building site after field measurements have been taken.
 - 2) Should interferences or discrepancies prevent the installation of any part of the work, the Owner's Representative shall be notified and he will determine the steps necessary to complete the true development of the intent of the drawings and specifications.
- b. Materials
 - 1) General
 - a) Unless otherwise specified or shown, pipe, fittings and general purpose valves for each piping system shall be as specified in Paragraph 2.5, Piping Specification Sheets. The Piping Specification Sheets are a summary of the materials and appurtenances to be used for each system; whereas the detailed requirements for each type of pipe are given in Paragraph 2.2.
 - b) Pipe thickness classes are given in Paragraph 2.2, Pipe and Fittings, and Paragraph 2.5, Piping Specification Sheets. In some cases, the piping thickness class is noted on the plans. If there are any conflicts within the specifications or between the drawings and the specifications, use the stronger pipe class. Contractor shall submit calculations with shop drawings where specified.
 - c) Piping shall have a minimum cover of 18 inches unless otherwise shown on the drawings.

- d) Whenever the maximum allowable trench condition for the pipe used is for any reason exceeded, as shown on the drawings, or accepted pipe design criteria is modified, the Contractor shall at his expense provide evidence that the pipe strength is adequate to carry the increased load or cradle the pipe in concrete in a manner acceptable to the Engineer. Calculations shall be submitted for the proposed method of correction.

2) Piping System

- a) Piping designation: Piping is designated by a 2-part code consisting of:
 - (1) Pipe diameter in inches.
 - (2) An abbreviation and/or word indicating the service.
- b) For example, the designation 8" SD shall mean an 8-inch diameter storm drain line. Refer to the Piping System table herein for the services, operating pressure, temperatures and testing information as specified. Piping and fitting materials are listed in the piping specification sheets.
- c) Paint exposed piping above and below process water surfaces: See Section 09900 for coatings. This includes all piping exposed in building, structures, tanks, and below grade vaults.
- d) Pipes encased in concrete: Ferrous metal piping encased in concrete shall not require a coating. The pipe shall be cleaned to remove mill scale prior to encasement. The lining shall be the same as required for the unencased piping.

1.3 SUBMITTALS

- a. American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (*in a format substantially matching that outlined in Section 01610*), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item).
- b. General: Shop drawings and product data shall be submitted in accordance with the requirements of Section 01300, Submittals and Section 15000, Mechanical, General.
- c. Shop drawings shall include Contractor prepared plans, sections and details fully dimensioned showing piping systems and appurtenances to be installed and with system designations as indicated herein. Show equipment connection details.
- d. Product data shall include manufacturer's literature, catalog cuts and other descriptive literature to substantiate the conformance with specifications of materials and equipment submitted. Mark product data to indicate exactly those items that are to be provided and cross out unrelated or no applicable items.

- e. Submittals for HPDE Pipe shall include all of the above information as well as the following.
 - 1) A certificate from the pipe manufacturer stating that the materials have been sampled and tested in accordance with industry standards and meet the requirements of the designated specification. The certificate shall be signed by an authorized agent of the manufacturer.
 - 2) Copies of certificates showing current manufacturer certified fusion training for the personnel who will be performing the heat fusion joining of pipe and fittings. The fusion training shall be a minimum of 8 hours, and shall be current within 12 months prior to performing the heat fusion joining.
 - 3) Description of the methods and equipment used for pipe fusing.

1.4 JOB CONDITIONS

- a. Schedule of work: Arrange work to comply with schedule of construction. In scheduling, anticipate means of installing equipment through available openings in structure.
- b. Coordination of work: The Contractor shall coordinate trades whose work is adjacent, in order to avoid field interference and delay in execution of the work of other trades. Furnish detailed advance information regarding requirements related to work by other trades. Furnish sizes and accurate data and location of foundations, pits, chases, holes through beam, floors, walls, ceilings and roof, and other special openings required for this contract work.
- c. Inserts: Prior to the execution of each step in the general construction work, determine that chases and holes required for the specified work are properly located and sized and supervise the setting of sleeves, inserts and other required build-in items. If this preliminary work is not properly performed, and should cutting be required to install the specified work, the Contractor shall bear expense of cutting and restoring the construction to its original condition.
- d. Cutting: The work shall be laid out in advance and any cutting of construction shall be done only with the written permission of the Engineer. Cutting shall be carefully done, and any damage to the building, piping, wiring and equipment as a result of the cutting shall be repaired by persons skilled in the particular trade at no additional cost to the City.

PART 2: PRODUCTS

2.1 COUPLINGS

- a. Flanges, gaskets and bolts: Cast-iron flanges shall conform to ANSI B16.1, Class D. Flanges shall be flat faced unless otherwise noted. Flange gaskets shall be full-face type, synthetic rubber or other material, suitable for the intended service. Substitution of other gasket materials shall be only with the express written consent of the Owner's Representative or as noted herein. Gasket thickness shall be 1/16 inch for pipe 10 inches and less and 1/8 inch for larger pipe. Flange assembly bolts shall be heavy pattern hexagon head carbon steel machine bolts with heavy pattern, hot pressed, hexagon nuts,

all ANSI B18.2. Threads shall comply with ANSI B1.1, coarse threads series, Class 2 fit. Bolts and nuts for use in submerged service shall be stainless steel. Bolts and nuts for stainless steel flanges shall be stainless steel.

- 1) Forged steel flanges, where required, shall be raised face, welding neck, conforming to ASTM A181 Grade 1 and ANSI B16.5. Forged steel flange gaskets shall match raised faces and shall be synthetic rubber or other material, suitable for the intended service. On 3-1/2-inch forged steel flanges and smaller, gaskets shall be 1/16 inch thick. Forged steel flange assembly bolts shall be alloy steel studs, ASTM A193 with 2 F.S. hexagon nuts ASTM A194 per stud.
- b. Pipe threads: Unless otherwise noted, pipe threads shall conform in dimension and limits of size to ANSI B2.1 Class 2 NPT, taper pipe thread.
- c. Flexible rubber couplings, where shown or specified, shall be of resilient arch type specifically designed for the intended exposure and shall be standard or tapered as shown. Couplings shall be filled arch type.
 - 1) Couplings shall have a liner of neoprene and shall have a smooth surface to the flow, extending through the bore of each coupling in one single unbroken piece to fully face both flanges. The carcass of each coupling shall be constructed of elastomers with internal reinforcing materials sufficient to provide pressure resistance at temperatures in accordance with a design to burst safety factor of 3 to 1 and shall contain integrally molded flanges. Each coupling shall be covered with a heavy-duty neoprene-hypalon jacket designed to be resistant to abrasion, heat, petroleum products, ozone and weathering. Flanges shall be fitted with stainless steel retaining rings. Drilling and bolting shall comply with ANSI B16.1, Class 125, or as required. Couplings shall be rated for a minimum working pressure of 140 psig and shall be equipped with suitable expansion restraints designed for a minimum total pressure of 150 psig or as otherwise specified. Numbers and size of restraints shall be as determined by the manufacturer. Restraints shall be stainless steel.
 - 2) Flexible couplings shall be synthetic rubber and fiberglass or polyester spool type, single arch, American Rubber Manufacturing Co., Style P or LD, Belmont, Style 5204, General Rubber Style 1075 HT, or equal, depending upon pressure, suitable for operation with temperatures to a minimum of 220 degrees F, restrained as above.
 - 3) Flexible coupling shall be provided with stainless steel tie rods to provide pipe restraint. Number and size of tie rods shall be as required to withstand a test pressure of 150 psi. Tie rods, gusset plates and washers shall be stainless steel.
- d. Mechanical pipe couplings
 - 1) AWWA Ductile Iron Piping Systems. Mechanical pipe couplings shall be manufactured in two or more segments of cast ductile iron, conforming to A-536, Grade 65-45-12. Gaskets shall be pressure-responsive synthetic rubber, FlushSeal® type. Mechanical coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to physical properties of ASTM A-183, minimum tensile strength 110,000 psi (758450 kPa) as provided standard

Victaulic. Victaulic Style 31.

- a) Transition Couplings: For transition between IPS steel and AWWA ductile iron sized pipe. Housings cast with offsetting, angle-pattern, bolt pads. Victaulic Style 307.
 - b) Coupling Gaskets: Synthetic rubber, FlushSeal® configuration, manufactured of elastomers as designated in ASTM D-2000.
 - (1) Reference shall always be made to the latest published Selection Guide for Victaulic Gaskets for proper gasket selection for the intended service.
 - c) Flange Adapters: For use with AWWA grooved end pipe and fittings, for mating to ANSI Class 125 flanged components. Victaulic Style 341.
- 2) Stainless Steel Piping Systems. Stainless Steel Grooved Couplings: Manufactured in two or more segments of cast stainless steel, conforming to ASTM A-351, A-743, and A-744. Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. (Gaskets used on potable water systems shall be UL classified in accordance with ANSI/NSF-61 for potable water service.) Mechanical coupling bolts shall be stainless steel, type 316, meeting the physical properties of ASTM A-193, grade B8M, Class 2.
- a) Rigid Type: Cast with key designed to clamp the bottom of the groove to provide an essentially rigid joint. Victaulic Style 489.
 - b) Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 77S.
 - c) Lightweight Flexible Couplings: For sizes up to 4", use in locations where vibration attenuation and stress relief are required. Unique design permitting assembly by one bolt/nut removal. Victaulic Style 475.
 - d) Flange Adapters: For use with grooved end pipe and fittings, for mating to ANSI Class 150 flanged components. Victaulic Style 441.
- e. Modular mechanical expanding rubber seals (link seals) shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and wall opening. The seal shall be constructed so as to provide electrical insulation between the pipe and wall, thus reducing chances of cathodic reaction between these 2 members. All hardware used for modular mechanical seals shall be stainless steel.
- 1) Contractor shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabricating or installing. The inside diameter

of each wall opening shall be sized as recommended by the manufacturer to fit the pipe.

- f. Unions 1-1/2-inch and smaller: Ground joint, malleable type; 2 inches and larger, flange type. Grinnel, Crane, Walworth, or equal.
 - 1) PVC Unions. PVC unions shall be provided with Viton O-rings.
- g. Dielectric unions shall meet the dimensional requirements and tensile strength of pipe unions in accordance with Fed. Spec. WW-U-531. The unions or flanges shall be suitable for the required operating pressures and temperature conditions. The unions shall have metal connections on both ends of union. The ends of the unions shall be threaded or soldered to match adjacent piping. The metal parts of the union or flange shall be separated to prevent current flow between the dissimilar metals.
- h. Escutcheons shall be Grinnel Figure 13 nickel-plated, or equal.
- i. Flange Adapters For Buried Pipe. Flange adapters in buried locations shall be Flange x MJ style adapters, with or without retainer glands as specified or shown on the drawings.
- j. Flange Adapters for Exposed Pipe.
 - 1) Where shown on the drawings or approved by the Owner's Representative, flange adapters for connecting plain-end pipe to flanged fittings or in making custom ductile iron spools in exposed (not buried) locations shall be Mega-Flange Series 2100, as manufactured by EBBA Iron, or approved equal.
 - 2) Restraint devices for nominal pipe sizes 3 inch through 36 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA/ C111/ A21.11. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts. Gland body, wedges and wedge actuation component shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536, and shall be fusion bond epoxy coated.
 - 3) Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly. Flange adapters shall be designed to allow at least 0.8-inches gap between the cut end of the pipe (6" & larger) and the mating flange without affecting the integrity of the seal.
- k. Flange Coupling Adapters. Where called for on the drawings flange coupling adapters for buried service shall be restrained flange coupling adapters. Flange Body shall be ductile iron, meeting or exceeding ASTM A 536, Grade 65-45-12. Flanges shall meet the dimensional requirements of ANSI Class 125 and 150 bolt circles. Gaskets shall be compounded for water and sewer service in accordance with ASTM D 2000 (Sizes 3 - 12" have flange O-Ring gasket). All bolts and nuts shall be stainless steel. All ductile

iron components of the adapter shall be fusion bonded epoxy coated on the inside and outside. Flange coupling adapters shall be Romac Model RFCA or approved equal.

1. Dismantling Joints. Where called for on the drawings furnish and install dismantling joints as follows.
 - 1) Dismantling joints shall have AWWA Class D Flanges compatible with ANSI class 125 and 150 bolt circles. The body of the joints shall be ASTM A536 ductile iron meeting or exceeding grade 65-45-12. Gaskets shall be designed for wastewater service. Restraint shall be provided by a wedge type set screw retainer gland. Restraining bolts and lugs shall be ductile iron.
 - 2) Dismantling joints shall be provided with a fusion bonded epoxy coating inside and outside.
 - 3) Dismantling joints shall be model DJ405 as manufactured by Romac Industries, Inc., or approved equal.

2.2 PIPE AND FITTINGS

- a. Stainless-steel pipe larger than 2 inches shall meet the requirements of ASTM A312 or ASTM A409. The interior surface of the pipe shall be smooth with no protrusions, stiffeners, or bracing, including at branch connections. Stainless-steel pipe shall be schedule 40S thickness unless otherwise noted for specific usage.
 - 1) Ends of pipes shall be threaded with couplings for 2-1/2 inches and smaller. For pipe 3 inches and larger pipes, pipe ends shall be but welded or grooved to receive the specified grooved coupling as shown on the drawings. Flexible style grooves and couplings shall be provided where shown on the drawings and as specified in Paragraph 2.1D. Where flanges are indicated they shall be 150-pound.
 - 2) Unless otherwise approved by the Owner's Representative no stainless steel piping shall be field welded. Certified welders shall perform pipe welds at an approved fabrication shop. Welds shall conform to the procedures for which the welder has been certified. The Contractor shall submit certification statements for the welders and the methods employed.
- b. Stainless steel pipe 2-inches and smaller shall be Schedule 40 Type 304L seamless, pickled and passivated and conforming to ASTM A312 with threaded ends conforming to ASME B1.20.1 for NPT pipe taper threads. Fittings shall be forged 1,000 CWP, ASTM A182 Grade 304L castings in compliance with ASTM A351 with NPT threaded connections in accordance with ASME B1.20.1. Fittings shall be assembled utilizing PTFE thread tape only.
- c. Ductile-iron pipe and fittings: Ductile-iron pipe shall conform to the current provisions of ANSI A21.51. Unless otherwise designated, ductile-iron pipe shall be standard thickness Class No. 53
 - 1) All grooved ductile iron pipe shall be thickness Class 53. Other thickness classes

shall be as noted on the plans or in under Paragraph 2.5, Piping Specification Sheets.

- 2) Pipe and fittings shall be flanged, grooved, mechanical joints or flexible joints as required, as shown on the drawings, or as specified. Unless otherwise shown on the drawings or specified herein, push-on joint pipe shall be used for underground installation, provided it is restrained at bends, tees and dead-ends. Concrete blocking at buried joints shall be provided for joint restraint. Use of mechanical joint with retainer gland and set screws without a concrete thrust block will not be permitted as a suitable restrained joint. Mechanical joints, exclusive of grooved mechanical, shall not be used for exposed piping. Joints of the type specified shall conform to ANSI A21.10 and A21.11. Gaskets shall be Buna-N or as shown in the Piping Specification Sheets.
- 3) Unless otherwise noted on the plans, ductile-iron pipe grooving shall be "flexible radius cut grooved" per AWWA C606, and as specified under Paragraph 2.1 D, mechanical Pipe Couplings and Flexible Pipe Couplings. Ductile-iron pipe shall be cement-lined and seal-coated according to ANSI A21.4.
- 4) Buried Restrained Push-on Joint Ductile Iron Pipe. Where shown on the drawings or specified in Paragraph 2.5, Piping Specification Sheets, buried or restrained joint ductile iron pipe shall have a flexible, positively restrained boltless push-on joint system capable of being deflected after assembly (field lock style gaskets).

d. Polyvinylchloride (PVC) pipe

- 1) PVC Pressure Pipe Less than 4-inch diameter: Polyvinylchloride (PVC) material for pressure pipe fittings and couplings shall conform to ASTM D 1784, Type 1, Grade 1, with 2,000-psi design stress. Pipe shall be Schedule 40 or 80 and shall be in accordance with ASTM D 1785. Thickness schedule shall be as specified on pipe specification sheets. PVC fittings shall be socket type conforming to ASTM D 2466/2467 unless specifically called out otherwise elsewhere on the specifications or drawings.
- 2) Exposed Piping Inside the DAF Building. The exposed piping inside the DAF building that is larger than 4 inch diameter shall be Schedule 80 PVC conforming to the above paragraph.
- 3) PVC Pressure Pipe Greater than 4-inch diameter to 12-inch diameter: Polyvinylchloride pipe shall be AWWA C900 (design stress of 4000 psi) with cast iron pipe equivalent outside diameter dimensions and shall be Class 150 pipe with wall thickness equivalent to a standard dimension ratio of (SDR) of 18. PVC shall comply with ASTM D 1784 and gasketed joints shall comply with ASTM D3139. The gaskets shall comply with ASTM F 477.
- 4) PVC Pressure Greater than 12-inch diameter: Polyvinylchloride pipe shall be AWWA C905 (design stress of 4000 psi) with cast iron pipe equivalent outside diameter dimensions and shall be Class 165 pipe with wall thickness equivalent to a standard dimension ratio of (SDR) of 25. PVC shall comply with ASTM D

1784 and gasketed joints shall comply with ASTM D3139. The gaskets shall comply with ASTM F 477. Flexible style grooves and couplings shall be provided where shown on the drawings.

- 5) Solvent Weld PVC Pipe. Solvent primer shall be IPS Weld-On P-70, and solvent cement shall be IPS Weld-On CPVC 724.
- 6) Push-On Joints
 - a) All push-on joints shall be single rubber gasket push-on joints conforming with the requirements of AWWA C-111 unless otherwise specified. Gaskets and lubricant shall be provided by the manufacturer of the pipe on which they are to be used.
 - b) Mechanical Joints. All components of mechanical joints shall be in conformance with AWWA C-111.
 - c) Joints Restrainers
 - (1) Joint restrainers shall be used at locations shown on the plans.
 - (2) The use of joint restrainers in lieu of concrete for thrust restraint is limited to applications specified in the Contract Documents or approved by the Owner's Representative. Joint restrainers shall be specifically designed for use on PVC pipe. Joint restraints at push on PVC bells shall be Series 1500/1600 for C900 PVC and Series 2800 for C905 PVC, as manufactured by EBBA Iron or approved equal.
 - (3) Retainer glands for restraining MJ fittings shall be used at locations shown on the drawings. Retainer glands shall utilize wedge type set screws and shall be "Mega-Lug" Series 2000 PV as manufactured by EBAA Iron Inc., or approved equal.
- 7) Threaded Joints: Threaded joints that are necessary to match up to threaded valves or fittings shall be made up with Spears Blue 75 thread sealant. Teflon tape or other brands of thread sealant will not be permitted. Threaded joints for the hypochlorite piping shall be made up with LOX-8 thread sealant.
- 8) Flanged joints shall be one piece, solvent-welded molded hub type with flat face PVC flanges, drilled to ASME B 16.5 Class 150, unless otherwise indicated. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick and shall be FKM, unless another material type is recommended by the equipment manufacturers. Flat ring gaskets 1/8-inch thick shall be utilized as a filler gasket whenever flat faced PVC flanges are attached to equipment or valves with a raised face flange to protect the PVC flange from bolting moment. Bolts shall be Grade B8M Type 316 stainless steel conforming to ASTM A193. Nuts shall be Grade 8M hex head nuts conforming to ASTM 194.

- 9) PVC gravity sewer pipe and fittings shall conform to ASTM D3034, with integral bell gasket joints. Rubber gaskets shall be factory installed and conform to ASTM F477. Pipe shall be installed according to ASTM test D2412.
- e. Polyethylene Tubing. Unless noted otherwise, tubing shall be flexible polypropylene tubing with sizes as shown on the drawings with a minimum working pressure of 123 psi and a minimum working temperature of 185 degrees F. A continuous length of tubing with no joints shall be run for all tubing segments.
- f. High Density Polyethylene pipe (HDPE)
 - 1) The requirements of HDPE pipe shall comply with AWWA C906 and as detailed below.
 - 2) High density polyethylene pressure pipe shall conform to ASTM D-3350 and ASTM F-714, pressure rating and DR, and outside diameter (OD) standard (i.e., IPS or DIPS) as specified herein or as shown on the drawings.
 - 3) Materials used for the manufacture of polyethylene pipe and fittings shall be PE 3408 high density polyethylene meeting cell classification 345464C for black pipe, or 345464E for stripes per ASTM D-3350, and shall be listed in the name of the pipe and filling Manufacturer in PPI (Plastics Pipe Institute) TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds, with a standard grade HDB rating of 1600 psi at 73°F. The manufacturer shall certify that the materials used to manufacture pipe and fittings meet these requirements.
 - 4) Polyethylene pipe 4" IPS, 4" DIPS and larger shall be manufactured to the requirements of ASTM F714 and AWWA C906-99 (IPS). Each production lot of material or pipe shall be tested for melt index, density and % carbon. Each production lot of pipe shall be tested for dimensions and ring tensile strength.
 - 5) Permanent identification of the piping service shall be provided by co-extruding color stripes into the pipe outside surface. The striping material shall be the same material as the pipe material except for color. Stripes printed on the pipe outside surface shall not be acceptable. IPS sized pipes shall have four equally spaced, longitudinal color stripes. DIPS sized pipes shall have three equally spaced pairs of longitudinal color stripes. The stripe color shall be green.
 - 6) HDPE pipe size standard (IPS or DIPS) and thickness shall be as noted on the plans or in Paragraph 2.5, Piping Specification Sheets.
 - 7) HPDE Pipe Fittings and Custom Fabrications
 - a) Polyethylene fittings and custom fabrications shall be molded or fabricated in conformance with pipe manufacturer requirements. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same minimum internal pressure as the mating pipe. Pressure de-rated fabricated fittings are prohibited.

- b) Unless otherwise approved by the Engineer, polyethylene pipe and fittings shall be supplied by the same manufacturer. Pipe and fittings from different manufacturers shall not be interchanged unless approved by the Engineer. Such approved will be subject to submittal of signed certification from both the pipe and fitting manufacturer that the pipe and fittings are fully compatible, as well as test results demonstrating this.
- c) Molded fittings shall be manufactured in accordance with ASTM D-3261, and shall be so marked. Each production lot of molded fittings shall be subjected to the tests required under ASTM D-3261.
- d) The manufacturer shall submit samples from each molded fittings production lot to x-ray inspection for voids, and shall certify that voids were not found.
- e) Fabricated Fittings. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full service pressure rating of the mating pipe. Directional fittings 16" and larger such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion on one outlet and flanged directional connection on the other outlets.
- f) Flange Adapters. Flange adapters shall be made with sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves to provide gasket less sealing, or to restrain the gasket against blow-out.
- g) MJ Adapters. MJ Adapters 14" and above shall be provided with Heavy Duty Back-up Ring Kits. Back up rings shall be stainless steel. All MJ adapters above 16" must be provided with Stainless Steel stiffeners. All bolts and nuts shall be stainless steel.
- h) Back-up Flange, Bolts. Adapters shall be filled with back-up rings pressure rated equal to or greater than the mating pipe. The flange back-up ring bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Backup flanges or rings shall be stainless steel. Bolts and nuts for backup flanges or rings shall be stainless.
- i) Fusion system: Pipe and fittings shall be joined to one another by the thermal butt fusion system. Polyethylene pipe lengths fittings, and flanged connections to be fused shall be of the same type, grade, and class of polyethylene compound and supplied by the same raw material supplier. The tensile strength of the joint at yield shall not be less than the pipe. Joints shall be made with equipment acceptable to the manufacturer

g. Brass Pipe and fittings shall be schedule 80 Thickness and comply with specifications

stipulated by ASTM B687, ASME/ANSI B1.20.1, ASTM B43-91. All fittings used for brass pipe shall be brass or cast bronze conforming to ASTM B.584, ASME/ANSI B.16.15.

- h. Galvanized Iron Pipe and fittings shall be ASTM A53 steel, Schedule 40. Threads shall be ANSI B2.1. Unions shall be galvanized malleable iron, ASTM A197 for materials and ANSI B16.39 for dimensions, with brass seats. Thread compound shall be Permatex No. , Crane equivalent, Teflon Tape, or equal. All fittings shall be galvanized malleable iron, screwed, ASTM A197 for material, ANSI B16.3 Class 150 for dimensions (rated 300 psi WOG at 150 degrees F.).
- i. Copper pipe shall conform to the requirements of ASTM B 88 - Seamless Copper Water Tube. 2.5-inch and smaller shall be hard drawn Type L for above grade applications. 3-inch and larger shall be hard drawn Type K for above grade applications. Exposed hot and cold water lines at plumbing fixtures shall be chrome over nickel-plated brass.
- j. Copper Pipe Joints.
 - 1) Copper tube shall have commercially pure wrought copper socket joints conforming to ASTM B88 with soldered joints and water flushable flux. Do not use cored solder.
 - 2) Joints 2.5-inch and smaller shall utilize 95-5 percent tin-antimony solder.
 - 3) Joints larger than 2.5-inch shall be completed by brazing. Brazed joints shall be made up using brazing filler metals that bond with the base metals being brazed and that comply with Specification for Brazing Filler Metal, ANSI/AWS A5.8. Brazed copper-to-copper joints shall be made using a copper-phosphorus brazing filler metal (BCuP series) without flux. The brazing alloy shall be sufficient to fill completely the annular clearance between the socket and the pipe or tube.
 - 4) Solder and brazing filler metals utilized in domestic water supply and potable water distribution system piping shall be lead free.
 - 5) Threaded Joints: Threaded joints shall be furnished as necessary to match up to threaded valves or fittings and shall be made up using threaded adapters with standard NPT pipe threads.
 - 6) Flanged joints shall be commercially pure wrought copper, socket joint, conforming to ASTM B88, faced and drilled with a 150-lb rating per ASME B16.24 standard. Bolts shall be zinc plated carbon steel conforming to the requirements of ASTM A307 Grade A. The corresponding nuts shall be zinc plated and shall conform to ASTM A563 Grade B. Gaskets shall be full face 1/16" thick non-asbestos compression type, as manufactured by Cranite or John's Manville.

2.3 WASHDOWN HOSES

- a. Furnish a total of six washdown hoses for use at the washdown stations. Hoses shall be Heavy Duty PVC lay flat hose rated for a maximum working pressure of 150 psi. Hoses shall be provided with male hose thread adapter on one end and a female hose thread

adapter on the other end. Hoses shall be model MD4421 7 USA Bluebook or approved equivalent.

2.4 PIPING SYSTEM TABLE

- a. The following table lists the piping specification applicable to the various piping system, the working pressure and temperature, and the pressure-testing data. Refer to Paragraphs 2.1, 2.2, and Part 3 for detailed specifications. In case of conflict, the more stringent specifications shall apply.

Abbreviation	System	Pipe Spec	Working Pressure (psig)	Maximum Working Temperature (Deg. F)	Test Medium	Test Pressure (psig)
RSFM-PVC	RAW SEWAGE FORCEMAIN- PVC	PVC-1	30	70	Water	150
RSFM-DI	RAW SEWAGE FORCEMAIN - DUCTILE IRON	DI-1	30	70	Water	150
RS-DI	RAW SEWAGE - DUCTILE IRON	DI-1	G	70	Air	Per paragraph 3.5b
SE-DI	SECONDARY EFFLUENT - DUCTILE IRON	DI-2	10	70	Water	50
SE-HDPE	SECONDARY EFFLUENT - HDPE	HPDE-1	10	70	Water	50
FE-DI	FINAL EFFLUENT- DUCTILE IRON	DI-2	G	70	Air	Per paragraph 3.5b
IRR-DI	IRRIGATION PIPING - DUCTILE IRON	DI-1	75	70	Water	150
IRR-PVC	IRRIGATION PIPEING - PVC	PVC-1	75	70	Water	150
SLFM-PVC	SLUDGE FORCEMAIN - PVC	PVC-1	20	70	Water	150
LPA	AERATION AIR	LPA	10	180	Air	25 psi for 60 minutes
HPA	COMPRESSED AIR	HPA	100	70	Air	200 psi for 60 minutes
BYP-DI	BYPASS LINE - DUCTILE IRON	DI-2	10	70	Water	50
BYP-PVC	BYPASS LINE - PVC	PVC-1	10	70	Water	50
DR-DI	DRAIN PIPING - DUCTILE IRON	DI-2	G	70	Air	Per paragraph 3.5b
DR-PVC	DRAIN PIPING - PVC	PVC-2	G	70	Air	Per paragraph 3.5b
WAS	WASTE ACTIVATED SLUDGE PIPING	WAS	30	70	Water	150
DAF-F	DAF FEED PIPING	DAF	30	70	Water	150
DAF-D	DAF DISCHARGE PIPING	DAF	30	70	Water	150
DAF-S	DAF SLUDGE PIPING	DAF	30	70	Water	150
CW	CARRIER WATER	PVC-3	50	70	Water	150
CS	CHLORINE SOLUTION	PVC-3	100	70	Water	150
SS	SULFUR DIOXIDE GAS AND SOLUTION	PVC-3	100	70	Water	150
COAG	COAGULANT	PVC-3	100	70	Water	150
POLY	POLYMER	PVC-3	100	70	Water	150
SD	STORM DRAINAGE	PVC-2	G	70	NA	NA
GS-PVC	GRAVITY SEWER - PVC	PVC-2	G	70	Air	Per paragraph 3.5b
GS-DI	GRAVITY SEWER - DUCTILE IRON	DI-2	G	70	Air	Per paragraph 3.5b
TV	TANK VENT	PVC-4	50	70	N/A	
SPD	SUMP PUMP DISCHARGE	PVC-3	50	70	No visible leakage	
UW	UTILITY WATER	PVC-3	75	70	Water	150
PW	POTABLE WATER	PW	75	70	Water	150
SP	SPARE CONDUITS	PVC-4	NA	NA	NA	NA

2.5 PIPING SPECIFICATION SHEETS

- a. The following piping specification sheets set forth the requirements for pipe, fittings and general purpose valves for piping system. Refer to Paragraph 2.2 for detailed specifications and to Part 3 for installation and testing. Where the Piping Specification Sheets call out trade names or specification, with or without the number, or additional features, they shall be additional to the detailed specifications in paragraph 2.2. In case of conflict, the more stringent specifications shall govern.

SYSTEM HDPE-1 (Gravity Service)

PIPE

Buried or Submerged:

HDPE. HDPE piping shall be ductile iron pipe size (DIPS) DR 17. with fusion joints. Flange joints shall be permitted where shown on the drawings and approved for use by the Engineer.

FITTINGS

Buried:

Buried fittings shall be HDPE fittings with the same pipe thickness as the pipe heat fused as specified above. All fittings shall be rated for the same pressure rating as the pipe. All hardware for pipe couplings, flange connections, and mechanical joint piping connection shall be stainless steel. All backing rings shall be stainless steel.

VALVES

As shown on plans and specified in Section 15100.

SYSTEM DI-1 (Pressure Service)

PIPE

Exposed (not including plant pump station wet well):

Ductile iron, AWWA C-151 Thickness Class 53 with cement mortar lined and seal coated interior surface in accordance with AWWA C104. Pipe joints grooved in accordance with AWWA C606 or flanged in accordance with AWWA C115. Exposed piping shall be painted in accordance with section 09900 and shall not be coated on the exterior with black bituminous paint. Exposed piping shall be painted with a primer coat compatible with the field coatings.

Buried, Embedded or Encased:

Ductile iron, AWWA C-151 Thickness Class 52 with cement mortar lined and seal coated interior surface in accordance with AWWA C104. Pipe joints push-on or mechanical joints in accordance with AWWA C111. No grooved couplings shall be permitted in non-exposed locations. Flanged joints in accordance with AWWA C115 permitted where specifically noted on the plans. Piping shall be coated on the exterior with a standard coating of black bituminous paint a minimum of 1 mil thickness. See drawings for locations of restrained joint pipe.

Plant Pump Station Wetwell:

Schedule 40 type 304L stainless steel with welded joints.

FITTINGS

Exposed (not including plant pump station wet well):

Cast ductile iron grooved or flanged fittings conforming to A-563, Grade 65-45-12. Fittings conforming to AWWA C 110 for center-to-end dimensions and AWWA C153 for or AWWA C110 for wall thickness. Grooved ends conforming to AWWA C606. Provide 1/16 inch rubber gaskets for all flanges.

Buried, Embedded, or Encased

Cast ductile iron mechanical joint or flanged fittings conforming to A-563, Grade 65-45-12. Fittings conforming to AWWA C110 and AWWA C153. Flanged fittings permitted only where specifically shown on the plans.

Note: All fittings shall have distinctly cast on the outside of the fitting the pressure rating, nominal diameter of openings, manufacturer's identification, and country where cast.

Plant Pump Station Wetwell:

Schedule 40S stainless steel, butt welding L.R. elbows, tees, caps and reducers, ASTM A 403, Grade WP 304L or fabricated from pipe.

VALVES

As shown on plans and specified in Section 15100.

SYSTEM DI-2 (Gravity Service)

PIPE

Exposed:

Ductile iron, AWWA C-151 Thickness Class 53 with cement mortar lined and seal coated interior surface in accordance with AWWA C-104. Pipe joints grooved in accordance with AWWA C606 or flanged in accordance with AWWA C-115. Exposed piping shall be painted in accordance with section 09900 and shall not be coated on the exterior with black bituminous paint. Exposed piping shall be painted with a primer coat compatible with the field coatings.

Buried, Embedded or Encased:

Ductile iron, AWWA C-151 Thickness Class 50 with cement mortar lined and seal coated interior surface in accordance with AWWA C-104. Pipe joints push-on or mechanical joints in accordance with AWWA C111. No grooved couplings shall be permitted in non-exposed locations. Flanged joints in accordance with AWWA C115 permitted where specifically noted on the plans. Piping shall be coated on the exterior with a standard coating of black bituminous paint a minimum of 1 mil thickness. See drawings for locations of restrained joint pipe segments.

FITTINGS

Exposed:

Cast ductile iron grooved or flanged fittings conforming to A-563, Grade 65-45-12. Fittings conforming to AWWA C110 for center-to-end dimensions and AWWA C153 for or AWWA C 110 for wall thickness. Grooved ends conforming to AWWA C606. Provide 1/16 inch rubber gaskets for all flanges.

Buried, Embedded, Encased, or Submerged (i.e., lagoon inlet piping):

Cast ductile iron mechanical joint or flanged fittings conforming to A-563, Grade 65-45-12. Fittings conforming to AWWA C110 and AWWA C153. Flanged fittings permitted only where specifically shown on the plans. Provide 1/16 inch rubber gaskets for all flanges.

Note: All fittings shall have distinctly cast on the outside of the fitting the pressure rating, nominal diameter of openings, manufacturer's identification, and country where cast.

VALVES

As shown on plans and specified in Section 15100.

SYSTEM PVC-I (Large Diameter Pressure Service)

PIPE

All Exposures:

4-inch to 12-inch. Rigid polyvinylchloride, AWWA C900 DR 18. Joints shall be integral bell gaskets.

14-inch to 36-inch. Rigid polyvinylchloride, AWWA C905 DR 25 Joints shall be integral bell gaskets.

FITTINGS

All Exposures:

Ductile Iron conforming to the requirements for Piping System DI-1.

VALVES

As shown on plans and specified in Section 15100.

SYSTEM PVC-2 (Gravity Service)

PIPE

All Exposures:

4-inches to 15-inches in diameter shall meet requirements of ASTM D3034, SDR 35.

18-inches to 27-inches in diameter shall meet requirements of ASTM F679.

Joints shall be integral bell gasketed joints conforming to ASTM D3212, and gasket material shall conform to ASTM F477.

FITTINGS

All Exposures:

Fittings shall be a minimum of SDR 35 wall thickness.

SYSTEM PVC-3 (Small Diameter Pressure Service)

PIPE

All Exposures:

2-inch and smaller. Rigid polyvinylchloride, NSF, Schedule 80 normal impact.

TUBING

All Exposures:

Where shown on the plans for flexible connections to equipment systems polyethylene tubing as specified in paragraph 2.2e shall be used. Where tubing is connected to other pipe types. The connections shall be made with threaded polypropylene compression fittings as manufactured by Jaco or approved equal. All tubing runs shall be continuous without intermediate couplings.

FITTINGS

All Exposures:

Rigid polyvinylchloride, NSF, Schedule 80, normal impact.

VALVES

Exposed:

2-inch and smaller; Isolating - ball, PVC, true union type as specified in Section 15100.

Buried:

Ductile iron body gate valves with 2-inch operating nut as specified in Section 15100.

REMARKS

For valve specification, see Section 15100. All exposed PVC pipe shall be painted with appropriate latex based paint for UV protection whether specified in Section 09900 or not.

SYSTEM PVC-4 (Low Pressure Service)

PIPE

Exposed:

Rigid polyvinylchloride, NSF, Schedule 40 normal impact.

Buried:

For the buried spare conduits between the DAF building and the existing pump building and between the DAF building and the chlorine injection manhole, rigid polyvinylchloride, NSF, Schedule 40 normal impact. Conduit shall be sunlight resistant manufactured in accordance with UL-651 electrical conduit, PW pipe, Canon, or approved equal.

FITTINGS

Exposed:

Rigid polyvinylchloride, NSF, Schedule 40, normal impact.

Buried:

For the buried spare conduits between the DAF building and the existing pump building and between the DAF building and the chlorine injection manhole, all bends shall be long-radius electrical sweeps. Pulling bells shall be as manufactured by Carlon, or approved equal.

VALVES

None.

SYSTEM LPA (Aeration Air)

PIPE

All Exposures:

3-inch and larger: Schedule 10S stainless steel, ASTM A 312, Type 304L, seamless, pickled with roll groove joints or flanges as shown on the drawings. No field welding permitted unless approved by the Engineer. Stainless steel flanged fittings shall be Class 150 with full facing gaskets, with flange and bolt patterns matching the piping being connected to, and shall be provided with centering rings where required. Flange bolts shall be 304 stainless steel.

FITTINGS

All Exposures:

3-inch and larger: Schedule 10S stainless steel elbows, tees, caps, and reducers, ASTM A 403, Grade WP304L or fabricated from stainless steel pipe conforming to ASTM A312, with factory grooved ends.

VALVES

As shown on plans and specified in Section 15100.

SYSTEM HPA (Compressed Air)

PIPE

Schedule 40S stainless steel, ASTM A312, Type 304L, seamless, pickled, and passivated.

FITTINGS

2-1/2-inch and smaller; screwed; nipples: ASTM A 312, Type 304, stainless steel, Schedule 40S seamless, bushings and plugs: stainless steel; elbows, caps, reducers and couplings: forged stainless steel 3,000 psi, screwed, ASTM A182, Grade F304. Branches: forged stainless steel, 3,000 psi screwed tees, ASTM A182, Grade F304.

3-inch and larger: Schedule 40S stainless steel, butt welding L.R. elbows, tees, caps and reducers, ASTM A 403, Grade WP 304L or fabricated from pipe. Flanges, bolting, gaskets and dope - same as 2- 1/2 inch and smaller.

FLEXIBLE TUBING

Connections between the Schedule 40 hard piping and all equipment, valves, and other pneumatic devices shown on the plans shall be made using flexible braided stainless steel hose fittings with MNPT threaded ends as shown on the drawings. Hose shall be model 16SM-A1 as manufactured by Flex Pipe USA, or approved equal. Hose length and size shall be as noted on the plans.

VALVES

As shown on plans and specified in Section 15100.

SYSTEM WAS (Waste Activated Sludge)

PIPE

Exposed Inside SBR Basins: Sch 80 PVC conforming to specifications for PVC-3 piping system.

Exposed Outside SBR Basins: Sch 10S Stainless Steel conforming to LPA piping system.

Buried: PVC AWWA C900 conforming to specifications for PVC-1 piping system.

FITTINGS

Exposed Inside SBR Basins: Sch 80 PVC conforming to specifications for PVC-3 piping system.

Exposed Outside of SBR Basins: Sch 10S Stainless Steel conforming to LPA piping system.

Buried: Ductile Iron conforming to the requirements for Piping System DI-1 or PVC conforming to PVC-1 piping system (contractor's option). Ductile iron spool shall be used to transition to stainless steel on the outside of the SBR basin as shown on drawing M214.

VALVES

As shown on plans and specified in Section 15100.

SYSTEM DAF (DAF System Piping)

PIPE

Exposed Inside DAF Building: Sch 80 PVC conforming to specifications for PVC-3 piping system.

Exposed in Exterior Locations (DAF Pump Station): Ductile Iron conforming to the specifications for the DI-1 piping system.

Buried Under Concrete Slabs: Ductile Iron conforming to the specifications for the DI-1 piping system. Ductile Iron Pipe shall extend a minimum of 5 feet beyond all wall footings or to the limits shown on the plans.

Buried (not under concrete slabs): Ductile Iron conforming to the specifications for the DI-1 piping system or AWWA C900 PVC conforming to the specifications for the PVC-1 piping system, Contractor's option.

FITTINGS

Exposed Inside DAF Building: Sch 80 PVC solvent weld or flanged fittings conforming to specifications for PVC-3 piping system.

Exposed in Exterior Locations and Buried: Ductile Iron conforming to the requirements for Piping System DI-1.

VALVES

As shown on plans and specified in Section 15100.

SYSTEM PW (Potable Water Piping)

PIPE

Exposed Inside DAF Building: Copper, Type L joints soldered or NPT.

Buried Under DAF Building Slab:

3-Inch and Smaller Pipe: Type L joints soldered or NPT. Copper Pipe shall extend a minimum of 5 feet beyond all wall footings or to the limits shown on the plans, whichever is greater.

4-inch and Larger Pipe: Ductile Iron conforming to the specifications for the DI-1 piping system.

Buried (not under concrete slabs):

3-Inch and Smaller Pipe: Sch 80 PVC conforming to the specifications for the PVC-3 piping system.

4-Inch and Larger Pipe: Ductile Iron conforming to the specifications for the DI-1 piping system or AWWA C900 PVC conforming to the specifications for the PVC-1 piping system, Contractor's option.

Trenchless Installation:

For the trenchless potable water installation under the creek, piping shall be HDPE (IPS) minimum thickness DR 11.

FITTINGS

Exposed Inside DAF Building: Copper Type L joints soldered or NPT.

Buried Under DAF Building Slab:

3-Inch and Smaller Pipe: Copper Type L joints soldered or NPT.

4-Inch and Larger Pipe: Ductile Iron conforming to the specifications for the DI-1 piping system.

Buried (not under concrete slabs):

3-Inch and Smaller Pipe: Sch 80 PVC conforming to the specifications for the PVC-3 piping system.

4-Inch and Larger Pipe: Ductile Iron conforming to the specifications for the DI-1 piping system.

VALVES

As shown on plans and specified in Section 15100.

2.6 UNDERGROUND WARNING TAPE

- a. Detectable or non-detectable acid and alkali resistant safety warning tape shall be provided with all underground pipelines. The tape shall consist of a minimum 4.0 mil (0.004") thick, virgin low density polyethylene plastic film formulated for extended use underground. The tape shall be in accordance with the APWA national color code and shall be permanently imprinted in lead free black pigments suitable for direct burial.

2.7 TONING WIRE

- a. A continuous insulated 14 gauge stranded copper toning wire with THHN insulation shall be supplied with non-metallic pipe. Insulation shall be blue in color for potable water piping or green for all other piping. Additional wire shall be supplied as necessary to allow the toning wire to be looped up at all valve boxes, manholes, junctions, etc.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General: The types and sizes of pipes to be used shall be as specified and shown. Where sizes or locations of small pipe are omitted from the drawings and not mentioned in the specifications, the sizes to be used shall correspond to the latest edition of the Uniform Plumbing Code requirements. In any event, undesignated pipe shall be proper for the functions to be performed and as accepted by the Engineer. Installation shall be in accordance with the manufacturer's written manual.
 - 1) Pipe shall be carefully placed and supported at the proper lines and grades, and where possible shall be sloped to permit complete drainage. Piping runs shown on the drawings shall be followed as closely as possible, except for minor adjustments to avoid equipment, architectural, and structural features. If major relocations are required, they shall be acceptable to the Engineer.
 - 2) In erecting the pipe a sufficient number of screw unions, flanged or grooved end type joints shall be used to allow any section or run of pipe to be disconnected without taking down adjacent runs. Flanged and mechanical pipe coupling joints shall be employed on pipelines 3 inches in diameter and larger. The provision of an adequate number of appropriate take-down fittings must be rigidly adhered to whether or not such fittings are indicated on the drawings. Take-down fittings shall also be provided for removal of valves and other appurtenances. Where piping passes through concrete or masonry walls, take-down fittings shall be employed as near the wall as possible. Dielectric unions shall be used at locations to join pipe or equipment of dissimilar metals. Eccentric reducers shall be used to keep the top of piping at pump suctions level.
 - 3) Unless otherwise specified, pipes passing from concrete or steel to earth shall be provided with a bell-and-spigot or flexible couplings. wherever a metallic pipe 1 inch in diameter or larger passes from concrete to earth horizontally, 2 flexible pipe couplings spaced from 2 feet to 4 feet apart depending on pipe size shall be installed, whether shown or not. Only one flexible pipe coupling is required on vertical runs from the Structure. One coupling shall be within 1 foot of the

structure. Particular care shall be taken to ensure a full support of the pipe in the earth between and beyond the joints.

- 4) Eccentric plug valves in piping shall be installed with seat upstream (unseating head) to prevent clogging.
- 5) Pressure taps on the suction and discharge sides of pumps, blowers, and compressors shall be provided with ball valves unless otherwise shown. Provide taps in piping for flow switches, pressure switches, etc., as required, to match instrumentation drawings. Taps to be a minimum diameter of 3/4 inch with bushings for smaller sizes. For taps larger than 3/4 inch, tap actual size to be coordinated with electrical instrumentation.
- 6) Unless otherwise specified, the suction and discharge of pumps, blowers, fans, and compressors shall be provided with flexible couplings suitable for the intended service.

b. Pipe supports

- 1) Pipe shall be secured in place by use of the standard piping support details shown on the General Mechanical drawings. The Contractor shall make use of these standard pipe supports in order to support the piping in accordance with the criteria outlined in the general mechanical drawings and specified herein.
 - a) Supplemental to the above, the contract drawings indicate the location of pipe stanchions and/or special supports where required.
 - b) In addition, in order to prevent swaying in piping system supported by hangers, the Contractor shall install side-sway bracing. Sway bracing shall be sufficient to eliminate horizontal pipe deflection during operation for all piping greater than 4 inches. As a minimum, sway bracing shall be installed at 20-foot intervals on system where hanger supports are used. In general, sway bracing supports are not shown on the drawing. Sway bracing supports shall be of the Contractor's design. Contractor shall provide design calculations for the engineer's review and approval. Sway bracing shall conform to the SMACNA Seismic Restraint Manual – Guidelines for Mechanical Systems.
- 2) Supports for exposed piping shall conform to the latest requirements of the ANSI Code for Pressure Piping B31-10 and MSS standard Practice SP-58, except as supplemented or modified by the requirements of this specification.
 - a) Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible.
- 3) Hanger supports shall be as noted, with at least one support adjacent to the joint for each length of pipe, at change in direction and at branch connections. Sufficient hangers shall be provided to maintain proper slope without sagging.

Support spacing shall not exceed the manufacturer's recommendations or those stipulated on the drawings whichever is more stringent.

- 4) Spacing of clamps for support of vertical piping shall be close enough to keep the pipe in alignment as well as to support the weight of the piping and contents, but in no case shall be more than 10 feet.
- 5) Provide adjustable hangers for pipes, complete with adjusters, swivels, rods, etc. Size hangers to clear insulation and guide where required, as well as support piping. Rigid hangers shall provide a means of vertical adjustment after erection. Hanger rods shall be machine-threaded. Continuous threaded or "all thread" rods will not be allowed unless otherwise noted.
- 6) Clevis or band-type hangers: Grinnel 260 or 269, Elcen, or equal, shall be provided. Strap hangers not permitted.
- 7) Provide floor stands, wall bracing, concrete piers, etc., for lines running near the floors or near walls and which can be properly supported or suspended by the walls or floors. Pipe lines near concrete or masonry walls may also be hung by hangers carried from wall brackets at a higher level than pipe. Hanging of any pipe from another is prohibited.
- 8) Equipment shall be so positioned and aligned that no strain shall be induced within the equipment during or subsequent to the installation of pipework.
- 9) When temporary supports are used, they shall be sufficiently rigid to prevent any shifting or distortion of the piping or related work.
- 10) Flexible couplings shall be installed where shown on the drawings and at such other points as may be required for ease of installation or removal of the pipe, subject to approval of the Engineer. Flexible couplings shall be of the restrained type where necessary to prevent separation of pipe due to internal pressure.
- 11) Materials: Pipe supports, hangers, racks and anchors shall be 304 stainless steel or hot-dip galvanized after fabrication. All support systems that are submerged or that are located within a tank, channel, or other structure designated to hold water shall be 304 stainless steel. This includes all support systems located over the vertical projection of the exterior vertical wall of channels and tanks.

c. Installation at concrete walls and footings

- 1) Whenever a pipeline of any material terminates at, or extends through, a structural wall or sump, the Contractor shall install in advance of pouring of concrete the fittings or special casting required for the particular installation.
- 2) Pipe to be cast in water-bearing walls or more than 4 feet below grade shall have water-stop rings. Water stop rings shall be cast integrally with pipe or fabricated. If fabricated, they shall be at least 6 inches larger diameter than pipe, 1/4-inch thick, and continuous welded all around on both sides.

- d. Piping Through Walls and Slabs
 - 1) Unless otherwise indicated, pipes passing through walls and slabs shall be installed in accordance with the standard details shown on the drawings.
 - 2) Care shall be taken to ensure no contact between embedded sleeves or pipes and reinforcing steel. Pipe must be isolated from reinforcing steel.
- e. Pipe welding: Welding of steel pipe shall be by the shielded arc method. Welders must be qualified for pipe welding in all positions and for the materials to be welded in accordance with the requirements of ASME Boiler and Pressure Vessel Code, Section IX. The Contractor shall provide the Owner's Representative with welding certificates specifically validated for this project. This certification supersedes all other certification requirements of other specifications noted herein.
 - 1) Butt welding of stainless steel shall be by the MIG or TIG method. Fillet welds at slip-on flanges shall be by MIG, TIG or SMA method. Qualification, certification shall be as noted above for steel piping.
 - 2) Gas purging of the backside of the weld during the initial root pass is required. Purge gas shall be the same composition as the shielding gas supplied to the welding gun.
 - 3) Fill and cover passes on butt welds are required to provide a cross section of weld metal equal to, or greater than, the parent metal.
 - 4) Welding, weld testing and weld repair shall be in accordance with ANSI B31.1 and B31.3, as applicable.
 - 5) Pipe welding on system not previously noted shall be per AWWA C206, and weld repairs shall be in accordance with AWWA C206.
- f. Pipe cutting: The Contractor shall perform work of cutting pipe and fittings or special castings necessary to the proper and accurate assembly, erection and completion of the work. Pipe shall be cut to fit accurately with smooth edges and faces.
- g. Pipe threads: Pipe ends shall be reamed to the full bore of the pipe. Threads shall conform in dimension and limits of size to ANSI B2.1, tapered pipe thread. In making up threaded joints, an accepted thread lubricant shall be applied to the male threads only.
- h. Flanged joints shall be made up square with even pressure upon the gaskets and shall be watertight.
- i. Grooved and shoulder-type joints shall be in accordance with AWWA C606.

j. Pressure piping

- 1) Anchorage: Concrete thrust blocks, unless otherwise indicated, shall be used to anchor pressure piping. As an alternative to thrust blocking pressure pipe may be anchored by connecting sufficient joints together to withstand the pressure test for that piping system specified in Paragraph 2.5 of this section. The Contractor shall submit the restrained end joint calculations to the Owner's Representative for review and approval.
- 2) Manual air vents and pipe drains: Manual air vents shall be installed at the high points of pipelines carrying liquid, except acids, caustics, or other dangerous liquids, as instructed by the Engineer, of any service class which cannot be vented through service connections or vent cocks provided with equipment. Manual air vents for liquid pipelines 2-1/2 inches and larger shall consist of a 1/2-inch valve as specified for flushing and for smaller piping shall be 3/8-inch size consisting of bronze cock and short copper tubing return. Vents shall include piping to floor level with valve located 4 feet above floor.
 - a) Exposed liquid lines 4 inches and larger shall be provided with a tap or guided nipple and valve drain on the bottom of the pipe. This drain connection shall be provided at low points with a spacing not to exceed that in the table and where shown. Size and minimum spacing shall be as follows:

Size	Water and Other Liquids	Sewage and Sludge
4" through 12"	1" at 200 Feet	2" at 200 Feet
14" and Larger	1" at 100 Feet	2" at 100 Feet

- b) Drain piping and isolating valves shall be the size noted above unless otherwise shown and shall be the same as shown in the Piping Specification Sheets. Drains shall be piped to a sump, gutter, floor drain or other collection point.
- c) Vent and drain provisions do not apply to buried or encased pipe except where shown.

k. Laying and jointing of buried piping

- 1) Pipe laying: Laying of ductile-iron, cast-iron, and steel pressure pipelines shall conform to applicable portions of Sections 6, 7 and 10 of AWWA C 600.
 - a) Anchorage shall be provided for fittings where there is a possibility of pulling the joint under pressure. Anchors shall be in accordance with applicable portions of AWWA C 600, except as otherwise shown.
 - b) Pipe shall be handled with canvas slings or devices to prevent damage to the pipe exterior. Each piece of pipe shall be laid in such a manner as to prevent any sudden offsets in the flow line. As the work progresses, the

interior of the pipe shall be cleared of dirt and debris of every description. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. At times when work is not in progress, open ends of pipe and fittings shall be closed.

- c) Unless otherwise indicated or directed by the Engineer, buried pipe shall be placed on a bedding material at least 6 inches deep below the barrel of the pipe. The bedding material shall be as specified in Section 02226.

2) Pipe jointing

- a) Mechanical joints or push-on joints shall be installed in accordance with the manufacturer's recommendations. Grooved and shoulder type couplings shall not be used for buried services.

1. Gravity pipelines

- 1) General: The types and sizes of pipe to be used shall be as specified and shown. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe pointing in the direction of flow. Each piece shall be laid true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line. As the work progresses, the pipe interior shall be cleared of dirt and debris of every description. Where cleaning after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. At times when work is not in progress, open ends of pipe and fittings shall be closed.

- a) Dewatering, excavation, backfill, bedding, etc., shall be in accordance with the contract drawings and other sections of these specifications.

m. Cutting Pipe

- 1) Where new or existing pipe requires cutting in the field it shall be done in a manner to leave a smooth end at right angles to the pipe centerline. The pipe shall be marked around its entire circumference prior to cutting.
- 2) After cutting and dressing or beveling, the reference mark on the spigot shall be accurately relocated and marked at the proper distance from the end as recommended by the manufacturer. The reference mark may be located by using a factory marked end of the same size as a guide.

3) Ductile Iron Pipe

- a) Ductile iron pipe shall not be flame cut.
- b) The cut end of the pipe shall be ground smooth as required. For push-on joint connections, the cut end shall be beveled as necessary to remove sharp edges which may damage the gasket. The width and general

appearance of the bevel shall closely resemble the bevel on an original pipe end.

- c) Any lining or coating damaged during the cutting process, as determined by the Owner's Representative, shall be cause for removing the damaged section by recutting the pipe or for rejecting the pipe altogether.

4) PVC Pipe

- a) For push-on joint connections, the cut end shall be beveled as specified herein.
 - b) Factory finished beveled end may be used as a guide to determine the angle and length of taper. The end may be beveled using a plastic pipe beveling tools which will cut the correct taper automatically. A portable type sander or abrasive disc may also be used to bevel the pipe end. Any equivalent tool or equipment which will produce a smooth bevel surface may be substituted.
- n. Temporary piping and pipelines: Temporary piping shall conform to the appropriate Piping Specification Sheet and shall be cleaned and tested according to Paragraph 3.2 of these specifications. Buried temporary lines shall be filled with sand, capped and abandoned in place or shall be removed. Temporary lines on the ground surface shall be removed and salvaged.
- o. The Contractor shall have on the site at all times three inflatable pipe plug for each size pipe up to and including 12 inches in diameter and one inflatable plug for pipes greater than 12 inches in diameter. The plugs shall be used to exclude dirt and debris from pipelines during construction. Temporary blocking of pipe with anything other than inflatable plugs (unless all are in use) will not be allowed.
- p. Unburied Restrained Push-On Joint Pipe. Where restrained joint ductile iron pipe and fittings having a flexible, positively restrained boltless push-on joint system capable of being deflected after assembly is installed in non-buried applications, the Contractor shall exercise care to ensure that the make-up slack is taken out of all joints during assemble prior to pressurizing the pipe.

3.2 HEAT FUSION JOINING OF HDPE PIPE

- a. The Contractor shall ensure that persons making heat fusion joints have received training in the manufacturer's recommended procedure. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction. Submittals to this effect shall be provided prior to starting fusion work.
- b. Joints between plain end pipes and fittings shall be made by butt fusion using only procedures that are recommended by the pipe and fitting Manufacturer. External beads shall not be removed.

- c. Butt Fusion of Unlike Wall Thickness. Butt fusion shall be performed between pipe ends, or pipe ends and fitting outlets that have the same outside diameter and are not different in wall thickness by more than one Standard DR, for example, SDR 13.5 to SDR 17, or SDR 11 to SDR 13.5. Transitions between unlike wall thickness greater than one SDR shall be made with a transition nipple (a short length of the heavier wall pipe with one end machined to the lighter wall) or by mechanical means or electrofusion.
- d. Butt Fusion Testing. On every day butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, then fusion test straps shall be cut out. The test strap shall be 12" (mm) or 30 times the wall thickness in length with the fusion in the center, and 1" (mm) or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.
- e. Joining by Other Means. Polyethylene pipe and fittings may be joined together or to other materials by means of (a) flanged connections (flange adapters and backup rings), (b) mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material, or (c) electrofusion. When joining by other means, the installation instructions of the joining device manufacturer shall be followed.
 - 1) Mechanical Joints. Polyethylene pipe and fittings may be joined together or to other materials by means of flanged connections (flange adapters and back-up rings) or mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material.
 - a) Mechanical joints and flange connections shall be installed in accordance with the manufacturer's recommended procedure, and shall be at the ambient temperature of the surrounding soil or liquid at the time they are bolted tight to prevent relaxation of the flange bolts and loosening of the joint due to thermal contraction of the polyethylene.
 - b) Flange faces shall be centered and aligned to each other before assembling and tightening bolts. In no case shall the flange bolts be used to draw the flanges into alignment. Bolt threads shall be lubricated, and flat washers shall be fitted under the flange nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the manufacturer.
 - c) Bolt Re-Tightening Required. At least 24 hour after initial assembly, flange connections shall be re-tightened following the tightening pattern and torque step recommendations of the manufacturer. The final tightening torque shall be 100 ft-lbs or less as recommended by the manufacturer.
 - d) Mechanical couplings shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer's recommendations, a longitudinal load applied to the mechanical coupling will cause the pipe to yield before the mechanical coupling disjoins.

External joint restraints shall not be used in lieu of fully restrained mechanical couplings.

- e) When an OD compression mechanical coupling is used, a stainless steel stiffener shall be installed in the bore of the polyethylene pipe.

3.3 COPPER PIPE INSTALLATION

- a. Soldered joints shall conform to the manufacturer's recommendations and to the specifications and recommendations of ASME B 31.1 - Power Piping. Prior to the application of flux, the ends of tubes shall be thoroughly dried and cleaned.
- b. Brazed Joints
 - 1) Techniques for completing brazed joints shall be as stated in Chapter 8, Brazed Joints, in the CDA Copper Tube Handbook.
 - 2) For 1-inch tube and larger, it may be difficult to bring the whole joint up to temperature at one time. The use of an oxy-fuel, multiple-orifice heating tip shall be utilized to maintain a more uniform temperature over large areas. A mild preheating of the entire fitting is recommended for larger sizes, and the use of a second torch to retain a uniform preheating of the entire fitting assembly may be necessary in larger diameters.
 - 3) The outside of all tubes, joints and fittings shall be cleaned by washing with hot water after assembly to remove any excess flux and provide for clear visual inspection of brazed connections.
 - 4) A visual inspection of each brazed joint shall be made to assure that the alloy has flowed completely around the joint at the tube-fitting interface. Where flux has been used, assure that solidified flux residue has not formed a temporary seal that could hold test pressure.
- c. Threaded Joints
 - 1) Threaded joints in piping systems shall be made up with polytetrafluoroethylene tape or other thread sealants suitable for the service type. Sealants shall be applied to the male threads only.

3.4 UNDERGROUND PIPING GRADE AND ALIGNMENT

- a. The Contractor's Surveyor shall provide line and grade stakes at 50-foot intervals or closer as judged necessary. The Contractor shall utilize sufficient string lines, targets, batter boards and survey instruments as necessary for accurate installation.
- b. Deviation from line and grade shall not exceed ½ -inch (0.04 feet) on line and ¼ -inch (0.02 feet) on grade at any point, provided such variations in grade do not result in a pipe or run of pipe having a level or reverse slope.

- c. Any pipe or run of pipe that has not been installed within the allowable tolerance for line and grade or gravity pipelines that impound water to any extent shall be removed and reinstalled or replaced as necessary to bring the work into compliance with the specified requirements.

3.5 UTILITY CONFLICTS

- a. The Contractor shall be responsible for exposing potential utility conflicts far enough ahead of pipeline construction to make necessary adjustments in grade and alignment of the new work as may be directed by the Owner's Representative.
- b. The Contractor shall be responsible for informing the Owner's Representative of the need for a grade and/or alignment adjustment.
- c. The Contractor shall not deviate from the design line and grade stated in these Contract Documents without the approval of the Owner's Representative.

3.6 PIPELINE TESTING

- a. General: Piping, both gravity and pressure pipelines, shall be subject to acceptance tests. Gravity sanitary sewer pipes with live services shall also be tested. The Contractor shall provide necessary utilities, bypass pumping equipment, labor and facilities for testing and shall dispose of waste, including water.
 - 1) Piping including valves, fittings, hydrants, etc., shall be pressure tested prior to backfill or connection to equipment such as pumps. For buried piping, perform test on no more than 300-foot sections, on exposed pipe no more than 100-foot sections. Test pipe penetrations with clean water in wet wells.
 - 2) Exposed piping shall be pressure tested and flushed in accordance with these specifications before they are either painted or insulated. Furthermore, no concrete or concrete slabs shall be poured over or around any piping (except wall penetrations) until the pipe has been tested for acceptance. If a piping system (or portion thereof) fails to meet an acceptance test, repairs shall be made at the Contractor's expense. The repair method used shall be subject to the Engineer's approval and the unacceptable portion shall be retested until it meets these testing specifications.
 - 3) The Contractor shall be responsible for submitting completed test report forms to the Owner's Representative for all sewer lines tested. The Contractor shall furnish the pump, pipe plugs, pressure gauges, compressor and other necessary equipment and perform pressure leakage tests on all mainlines and laterals unless otherwise directed by the Owner's Representative.
- b. Gravity Pipelines.
 - 1) Obstructions: After backfilling and restoration of surfaces, gravity pipelines shall be inspected for obstructions and shall be cleaned. Pipes less than 24 inches in diameter shall be cleaned using the sewer ball method. Lines larger than 36 inches in diameter may be cleaned by flushing as long as it is first visually

inspected to assure that no physical obstructions exist. Flushing shall be such that velocities are at least 2.5 feet per second.

- 2) All gravity sanitary sewers, including service laterals and appurtenances, shall successfully pass the air test prior to final acceptance and shall be free of leakage or visible infiltration of water.
- 3) Except as modified herein, test methods shall conform to the requirements of 2008 APWA Standard Specification, OSSC (ODOT/APWA) 00445.72.c, Air Testing, or local jurisdiction requirements, whichever are more stringent. Per OSSC (ODOT/APWA) 00445.75, visible infiltration of ground water in any pipe section (after completion of a successful air test) will be considered evidence that the original test was in error or that a failure of the section has occurred.
- 4) Sewer pipe thirty (30)-inches in diameter and larger may be tested using an approved pneumatic joint testing device. Such testing methods and equipment shall meet the approval of the Owner's Representative.
- 5) Sanitary sewers shall not be coated internally or externally with any substance of any kind in an effort to improve the performance of the pipe when tested.
- 6) Test Pressure Gauges. All pressure gauges used for pressure measurement shall be in excellent condition, and shall be provided with graduations not greater than 0.5 psi, with a minimum range of 0 to 9.0 psi. Any evidence of gauge damage or stickiness (ie. gauge will not zero, needle creeping upwards during test, needle moves to higher or lower reading when gauge is tapped, etc.) will result in the test being aborted until the gauge is replaced.
- 7) Minimum test pressure is 4.0 psi. Test pressure shall be increased by 0.433 psi for each foot of average ground water depth over the exterior crown of the pipe under test, with the maximum test pressure not to exceed 9.0 psi (for other than pneumatic joint testing devices approved by the Owner's Representative for larger diameter pipe as noted above).
- 8) The Owner's Representative may require testing of manhole-to-manhole sections as they are completed in order to expedite the acceptance of completed portions of the system and allow connections before the whole system being completed.

c. Pressure Pipelines

- 1) General: Test pressures and testing media shall be as specified in Piping System Table. Care shall be exercised to isolate equipment which is not rated for the specified test pressure to avoid damage to the equipment. System operating at less than 15 psi will be subject to 24 hours of leak proof operation as an additional requirement to pressure tests. Joints which will later be encased in concrete or insulated, whether buried or not, shall be tested prior to encasement. Pipe with leakage greater than allowed herein shall be repaired and retested at the Contractor's expense.

- 2) Gas and vapor system: Gas system operating under either positive pressure or vacuum shall have a leakage rate which does not exceed a 5% change in test pressure throughout the duration of the test as specified in the Piping Specification Sheets. Upon satisfactory completion of the test, the piping shall be blown out to remove welding slag, dirt and other foreign material.
- 3) Liquid system: Leakage for unburied liquid piping shall be zero throughout the duration of the test. Leakage for buried piping conveying chemicals shall be zero throughout the duration of the test. The allowable leakage for other buried piping shall be as listed below. Testing pressure shall be as specified in the Piping System Table.
 - a) The Contractor shall furnish the pump, pipe connections, taps, pressure gauges, auxiliary water container, bulkheads, plugs, calibrated containers and other necessary equipment and perform pressure and leakage tests on the pressure sewer pipes, including high pressure plugs (designed for the specified test pressure) at the discharge manhole or structure.
 - b) Unless noted otherwise the Piping System Table test pressures shall be of (100) psi, or 150% of the maximum working pressure, whichever is greater.
 - c) The contractor shall provide and install high-pressure plugs to insert into pipes that discharge into structures (e.g., headworks) as required to perform the pressure test described herein.
 - d) Test Pressure Gauges. All pressure gauges used for pressure measurement shall be in excellent condition, and shall be provided with graduations not greater than 2 psi. Any evidence of gauge damage or stickiness (i.e., gauge will not zero, needle creeping upwards during test, needle moves to higher or lower reading when gauge is tapped, etc.) will result in the test being aborted until the gauge is replaced.
 - e) Air Removal - Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the Owner.
 - f) Hydrostatic leakage testing shall be performed in conformance to the applicable sections of AWWA C-600, except as modified below. Unless otherwise authorized by the Owner, all hydrostatic leakage tests shall be witnessed by the Owner's Representative.
 - g) The test pressure shall be maintained for a minimum of two (2) hours and additional time as required for thorough inspection to find any leaks or defects in the water main and appurtenances. Should the pipe section

fail to pass the test, or if the test is aborted due to faulty pressure gauges, the Contractor shall find and correct failures and repeat the tests until satisfactory results are obtained, all at no additional cost to the Owner.

- h) Allowable Leakage. No pipe installation will be accepted if the leakage is greater than that determined by the formula outlined below.

$$L = SD(P)^{1/2}/133,200$$

Where:

L=allowable leakage, in gallons per hour

S=length of pipe tested, in feet

D=nominal diameter of the pipe, in inches

P=average test pressure during the leakage test, in pounds per square inch

NOTE: This formula is based on an allowable leakage of 11.65 gpd/mi/in. of nominal diameter at a pressure of 150 psi.

- i) The allowable leakage in gallons per hour at various pressures and pipe sizes is shown below. In the event of discrepancies between formulas and table values, the more stringent shall apply. All visible leaks shall be repaired regardless of the allowance used for testing. The maximum pressure drop over the duration of the test shall not exceed 5 psi.

ALLOWABLE LEAKAGE PER 1,000 FEET OF PIPELINE - <i>gph</i>										
AVG. TEST PRESSURE <i>Psi</i>	NOMINAL PIPE DIAMETER - <i>in.</i>									
	3	4	6	8	10	12	14	16	18	20
250	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37
225	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12
175	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84
125	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68
100	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50

- j) If the pipe structure under test contains sections of various diameters, the allowable leakage shall be the sum of the computed leakage for each size. No additional leakage allowance will be given for fire hydrant assemblies or valves.

- d. Potable water: Following satisfactory completion of the pressure test, potable water lines whatever diameter, shall be flushed, disinfected, flushed and tested, as specified below.

3.7 CLEANING

- a. All pipelines shall be cleaned and flushed with water.

3.8 PAINTING

- a. Pipe, fittings and appurtenances specified herein shall be painted in accordance with Section 09900. Pipes to be painted shall be sandblasted and primed with the specified primer, or equal, prior to installation.

3.9 MAINTAINING SANITARY SEWER FLOWS

- a. All sanitary sewer system components shall remain in service throughout the construction operations unless specific exceptions are approved in writing by the Owner's Representative.
- b. All construction that requires interruption of sanitary sewage flow shall be executed during periods designated by the City. Bypassing of untreated or partially treated wastewater to storm drains, ditches or surface waters is prohibited. Surcharging of upstream sewers is prohibited unless specifically approved in writing by the City.
- c. The methods used to maintain flow shall be the Contractor's design (subject to approval by the City), and may include bypass pumping, use of flow through plugs with periodic release of sewage flow, sewage hauling, etc. The bypass system, if used, shall be capable of conveying flows when the sewers are flowing full.
- d. Bypass pumping shall consist of furnishing, installing and maintaining all power, primary and standby pumps, appurtenances and bypass piping required to maintain existing flows and services. Bypass systems left in place or operated outside of normal working hours be provided with on-site 100% redundancy for the bypass pumping equipment, and shall be monitored continuously by the Contractor personnel unless alternate arrangements are proposed by the Contractor acceptable to the public agency with jurisdiction over the sewers (i.e. high level and pump fail alarm callouts, etc). The Contractor shall provide all submittal information required to demonstrate compliance with the requirements of the public agency with jurisdiction over the sewers.
- e. Bypass pumping shall be done in such a manner as not to damage private or public property, or create a nuisance or public menace. The pumped sewage shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the sanitary sewer system. Dumping or free flow of sewage on private property, gutters, streets, sidewalks, or into storm sewers is prohibited.

3.10 CLEANING POTABLE WATER PIPELINES

- a. All water pipelines shall be cleaned and flushed in accordance with AWWA C-651, Section 4.2.2.
- b. After the pressure test and prior to disinfecting, the water lines shall be thoroughly flushed through hydrants, blow offs or by other means as approved by the Owner's Representative, in a manner to achieve flushing velocities as required to completely remove all dirt, debris

and/or other deposits from the pipe.

- c. It shall be the Contractor's responsibility to provide all equipment, pipe, fittings, blowoffs (*temporary or permanent*) and/or appurtenances required to achieve flushing velocities.

3.11 DISINFECTING POTABLE WATER PIPELINES

- a. All potable water pipelines shall be disinfected as follows.
- b. Timing of Disinfection. Unless otherwise approved in writing by the Owner and the jurisdiction with authority, disinfection shall not occur on a weekend, or on a Friday or on any day that precedes a holiday, or where bacteriological testing would be required on any of these days.
- c. The Contractor shall furnish all required labor, equipment, taps, fittings, pipe, materials, appurtenances and apparatus, and perform the disinfection work in a manner to disinfect all portions of the pipeline and all service lines. If additional taps and open trenches at points of connection are required, the Contractor shall bear the responsibility of making such taps and maintaining open trenches until a satisfactory laboratory analysis has been obtained.
- d. All water mains and service lines shall be disinfected in accordance with the requirements of AWWA C-651, OAR 333-061 and/or the requirements under the Contract Documents, whichever is more stringent.
- e. Disinfection of Connections. For connections which cannot be disinfected in conjunction with the waterline mainlines (*as determined and approved in writing by the Owner's Representative on a case-by-case basis*), all fittings, valves and appurtenances (*including tool surfaces which will come in contact with potable water*) shall be thoroughly cleaned by washing with potable water and then swabbed or sprayed with a one percent (1%) hypochlorite solution (10,000 mg/L) in accordance with the requirements of AWWA C-651 and OAR 333-061.
- f. Waterline Disinfection by Hypochlorite Solution Required. Unless otherwise approved by the Owner's Representative (*such as for disinfection of connections, as summarized above*), water distribution mains shall be disinfected by pumping a concentrated hypochlorite solution into the pipeline as it is being filled (*ie. continuous-feed method per AWWA C-651, Section 4.4*), or other means approved by the Owner's Representative. Chlorinating powders (*if used*) shall be mixed with water, in proportions of 5% powder to 95% water by weight, mixed to a paste and thinned to a slurry suitable for pumping into the pipeline.
 - 1) NOTE: Use of the "tablet method" for waterline disinfection (*as summarized under AWWA C-651, Section 4.3*) is not included under OAR 333-061-00250(10)(b) as an acceptable disinfection method without special approval, and shall not be used unless approved in writing by the Owner's Representative and the AHJ prior to the installation of any pipe, and shall not be used where there is any chance of groundwater or other moisture entering the pipeline prior to completion of construction and disinfection. Any such approval shall be based on a detailed written plan and drawings submitted by the Contractor addressing all points under AWWA C-651, Section 4.3, including but not limited to defining the NSF 61 approved food grade adhesive to be used in attaching the tablets to the inside top of specified pipe segments, the method for marking the pipe where

each tablet is placed (*ie. pipe must be marked to ensure that pipe is installed with the tablets on the crown of the pipe*), the flowrate proposed for filling the pipe (≤ 1 fps velocity during filling), and the method for testing & ensuring that a minimum residual of 25 mg/L is provided at all points within the pipeline and along all service lines and hydrant leads. The 24 hour disinfection period shall not commence until the 25 mg/L concentration has been verified.

- g. Chlorine Application Method. Application of the concentrated hypochlorite solution shall be made by pumping into the fill end of the pipeline (*through a corporation stop provided by the Contractor*) as the pipeline is being filled. Where feasible, water may be supplied from the pressure side of a mainline valve to fill the new pipeline (*any pipeline filling operations shall be witnessed by the a City representative*), throttled to a very low flow. Extremities of the pipelines and service lines being disinfected shall be opened to ensure removal of air and ensure complete filling of the pipelines & service lines with chlorinated water.
- h. Chlorination to be Witnessed. Unless otherwise approved in writing by the City, a City representative shall witness (A) the application of the chlorine solution into the pipeline, (B) the chlorine residual testing prior to the start of the 24 hour disinfection period (*25 mg/L min*), (C) chlorine residual testing at the end of the contact period (*10 mg/L min*), (D) flushing of the mainline to eliminate the chlorine solution, and (E) the collection of the bacteriological samples (*Contractor is responsible to coordinate & schedule to allow the City representative to be present*).
- i. Minimum Chlorine Concentration for Disinfection, Chlorine Residual Testing.
 - 1) The dosage of chlorinating agent shall be of the amount to produce a minimum chlorine residual of 25 mg/L of free chlorine at all points in the pipeline, as well as along the length of all service lines, and along the length of all hydrant leads and/or fire service lines.
 - a) The Contractor shall open each meter stop until chlorinated water discharges from the end of each service line.
 - b) The Contractor shall open each hydrant until chlorinated water discharges from the end of each line.
 - c) The Contractor shall open a blowoff on the end of each fire service line until chlorinated water discharges from the end of each line.
 - 2) Chlorine Residual Testing by Contractor. Tests with the DPD method shall be made at selected points (*including the meter-stop end of water service lines, blowoffs, hydrants, etc.*) to determine the actual chlorine residual.
- j. Maximum Chlorine Concentration. Unless otherwise approved (*prior to the start of disinfection*) in writing by the Owner and the jurisdiction with authority, disinfection shall not result in chlorine concentrations greater than 100 mg/L at any point in the line.
- k. Chlorine Contact Time. Treated water shall be retained in the lines for sufficient contact time to accomplish the desired disinfection but not less than 24 hours.
- l. Valve Operation during Disinfection Period. All valves in the mainline segment being tested, other than valves used to isolate the mainline test segment (*including valves on hydrant leads*), shall be operated at least once during the first half of the disinfection period

(ie. closed and then re-opened, to ensure that all exposed parts of each valve is exposed to the chlorine solution).

- m. Chlorine Concentration at End of Contact Time. At the end of this 24 hour disinfection period, the treated water in all portions of the main shall have a remaining residual of not less than 10 mg/L free chlorine (*residual testing by Contractor, witnessed by City*). If the chlorine concentration is found to be less than 10 mg/L, the line shall be rechlorinated.
- n. Chlorine Flushing & Bacteriological Testing.
 - 1) If the free chlorine concentration is found to be 10 mg/L or more, the chlorine solution shall be drained or flushed at a controlled rate such that the waterline and service lines are filled with potable water, and a minimum of two consecutive samples taken at least 16 hours apart shall be collected from the waterline for microbiological analysis per OAR 333-061-0050(10)(b)(C) (*ie. one sample immediately after flushing, and another sample a minimum of 16 hours later*).
 - 2) Contractor to pay for laboratory analysis of all required water samples.
 - 3) Per OAR 333-061-0050(10)(b)(C):
 - a) “If the results of both analyses indicate that the water is free of coliform organisms, the pipe may be put in service.”
 - b) “If either sample indicates the presence of coliform bacteria, the pipe may be re-flushed, filled with potable water and resampled.”
 - c) “If this second set of samples is free of coliform bacteria, the pipe may be put into service, otherwise the disinfection and flushing process must be repeated until samples are free of coliform.”
 - 4) Should the initial flushing and/or disinfection prove ineffective, additional flushing and/or chlorination shall be repeated at no additional cost to the Owner until confirmed tests show acceptable results.
- o. Capping of Chlorination Taps, Pressure Test Taps, Sample Taps, etc.
 - 1) Unless otherwise approved or required by the City, all extra pipe and fittings attached to chlorination, pressure test or temporary sampling taps shall be removed and the corporation stop capped at the mainline tap or saddle after the new waterline is placed in service (*to avoid depressurizing the mainline after disinfection*). Wrap each capped corporation stop in plastic prior to backfilling.
 - 2) The location of all such capped corporation stops shall be shown on the Contractor’s record drawings.
- p. Disposal of Heavily Chlorinated Water
 - 1) Unless otherwise approved, the chlorine residual of water being disposed of shall be neutralized by treating with one of the chemicals listed below.

Pounds of Chemicals Required to Neutralize Various Residual Chlorine Concentrations in 100,000 Gallons of Water				
Residual Chlorine Concentration Mg/L	Sulfur Dioxide (SO ₂) Lb	Sodium Bisulfite (NaHSO ₃) lb	Sodium Sulfite (Na ₂ SO ₃) lb	Sodium Thiosulfate (Na ₂ S ₂ O ₃ · 5H ₂ O) lb
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

- 2) A substantial excess of dechlorinating chemical may be harmful to the environment. Care should be exercised to balance the amount of dechlorinating chemical against the chlorine present.
- 3) The dechlorinating chemical shall not be added directly to the water holding structure.

**SECTION 15100
VALVES AND GAUGES**

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

- a. The work covered by this section consists of valves and gauges.

1.2 SUBMITTALS

- a. General: Submittals shall be in accordance with Section 01300.
- b. American Iron & Steel (AIS) Requirement. Certification letter signed by the manufacturing company representative (in a format substantially matching that outlined in Section 01610), stating that all iron and steel products and components provided are in full compliance with AIS requirements (listing each item, and the location of manufacturer for each item).
- c. Product data: Complete literature of the manufacturer describing in full the characteristics of each item and shall include calculations as required. Include requirements for storage and handling and installation instructions.
- d. Shop drawings: Submit drawings showing complete dimensions, weights, and materials of construction. Special mounting requirements shall be identified.
- e. Insertion valve installer qualifications and certification from valve manufacturer demonstrating that the installer is a certified by the valve manufacturer for installation of the specified insertion valve.

1.3 MANUFACTURER

- a. Manufacturer shall be of established good reputation, regularly engaged in the fabrication of such equipment. Unless otherwise noted, any equipment offered shall be current modifications which have been in successful regular operation under comparable conditions.

PART 2: PRODUCTS

2.1 GENERAL

- a. Valves shall be manufacturer's standard design unless otherwise specified and shall be furnished with operating wheel or wrench nut. Unless otherwise indicated, the direction of rotation of the wheel or wrench nut to open the valve shall be to the left (counter-clockwise) and shall have cast thereon the word OPEN. Unless otherwise specified or shown on the drawings, 2-1/2 inch or larger buried valves shall have nonflanged ends (unless specifically called for otherwise on the construction drawings), 2-1/2 inch or larger exposed valves shall have flanged ends, and 2 inch or smaller valves shall have threaded ends. Flanges shall conform to ANSI B16.5. A union flanged, grooved or shouldered type connection shall be provided within 2 feet of each threaded end valve

unless the valve can be otherwise easily removed and such technique of removal is approved by the Engineer.

- b. Valves of the same type shall be from a single manufacturer.
- c. Valve boxes, in accordance with the drawing details, extending to the finished or established ground or paved surfaces shall be provided for buried valves. Covers for all boxes shall have cast thereon an appropriate name designating the service for which the valve is used. All valve boxes shall be set in 8-inch by 8-inch by 4-inch thick concrete pad at ground except where valve box is set in concrete sidewalk.
- d. Buried valves shall have wrench nut operator complying with Section 20 of AWWA C500. Wrench nuts shall be provided on buried valves, on valves which are to be operated through floor boxes, and where shown. Wrench nuts shall comply with Section 20 of AWWA C500. Extend shafts to within 6 inches from grade, and support every 5 feet with the last support just below the operating nut. Wrenches shall be 3-feet-6-inches long.

2.2 VALVE COATING

- a. Unless otherwise specified, all valves shall be furnished with a fusion-bonded epoxy coating inside and outside conforming to the requirements of AWWA C-550.

2.3 VALVE OPERATORS

- a. Manual operators: Manual operators shall, unless otherwise specified, be equipped with a geared operating wheel. Water tight operations shall be required for submerged or buried applications.
- b. Valve Wrenches: Unless otherwise specified, T-handle valve wrenches shall be delivered to the Owner by the Contractor prior to final acceptance. A minimum of two (2) valve wrenches, or one (1) valve wrench for each five (5) square nut operated valves or portion thereof, whichever is greater, shall be supplied by the Contractor. The length of the valve wrench stems shall be such that the valves can be properly operated from a standing position (i.e., handle at ± 3 feet above floor or finish grade).
- c. Unless otherwise specified or shown on the drawings, handwheel operators shall be provided on all exposed valves. Handwheels shall be of the spoked type only. An arrow with the word "OPEN" shall be cast into the handwheel, located so as to be readily readable, showing the opening direction of the valve. The outside diameter of the handwheels shall not be less than shown on the table below.

Valve Diameter (inches)	Minimum Diameter of Handwheel (inch)
3	10
4	10
6	12

8	14
10	16
12 & larger	16

2.4 GATE VALVES

- a. Unless otherwise specified or shown on the drawings, all gate valves shall be resilient seat wedge gate valves.
- b. Except as modified herein, gate valves and appurtenances shall conform to the requirements of AWWA C-509 or AWWA C-515 covering iron-body, resilient seat non-rising stem gate valves 3-inches through 12-inches diameter.
- c. All internal parts shall be accessible without removing the valve from the line. The top stem O-rings shall be field replaceable (in the full open position) without removing the valve from service.
- d. Valves shall be tested and certified by the manufacturer for shut-off at a working pressure of 200 psi and shell tested to a minimum pressure of 300 psi.

2.5 IRRIGATION AND DAF PUMP CHECK VALVES

- a. Irrigation and DAF pump check valves shall be swing type check valves conforming to the requirements of AWWA C-508.
- b. Swing check valves shall be fusion-bond epoxy coated (both inside and outside) cast-iron body, bronze mounted with outside lever and adjustable weights, flanged connections, and shall have hinge pins of hardened corrosion resistant alloy. Discs shall be cast iron with bronze facing.
- c. The check valve shall be rated for a continuous working pressure of 175 psi for valves up to 12-inch diameter, and 150 psi for valves larger than 12-inch.
- d. Standard swing check valves shall be Mueller Figure 13.4, Valmatic Series 7800 Swing Type Lever and Weight Check Valve, or approved equal.

2.6 PLANT PUMP STATION CHECK VALVES

- a. Plant pump station check valves shall be a rubber flapper swing check valve with a ductile iron body and cover. The body shall be long pattern design (not wafer), with integrally cast-on 125 pound, full faced end flanges, drilled per ANSI B16.1.

- b. The flapper shall be Buna-N having an O-ring seating edge and be internally reinforced with steel. The flapper shall be easily removed and replaced without the need to remove the valve from the line.
- c. The seating surface for the flapper shall be on a 45° angle requiring the flapper to travel only 35° from closed to full open position. The check valve shall have full pipe size flow area, except that 4-inch valves shall have a free flow area large enough to pass 3-inch solids ($\pm 185\%$ flow area) without clogging.
- d. The check valve shall be rated for a continuous working back pressure of 175 psi.
- e. Check valve(s) shall be provided with a bronze backflow device(s) with a T-handle operator as provided by Val-Matic, or approved equivalent.
- f. Unless otherwise specified, all valves shall be furnished with a fusion-bonded epoxy coating inside and outside conforming to the requirements of AWWA C-550.
- g. Check valves shall be Val-matic Series 500, or approved equivalent.

2.7 BALL VALVES

- a. Ball valves for plastic pipe systems 2 inches and smaller shall be PVC, double union, full port valves. Socket or threaded end connections as shown on the drawings. PVC body, Teflon (PTFE) seats with Viton O-ring seals, minimum pressure rating of 225 psi. PVC ball valves shall be Asahi Type 21, Hayward True Union, or equal.
- b. Ball valves for metal pipe systems shall be stainless steel or brass as noted on the drawings.
- c. Brass ball valves shall have a forged brass body with chrome plated balls and Teflon (PTFE) seats. End connections shall be threaded and valves shall be of full-port design. Valves shall be rated for 300 psi WOG. Brass ball valves shall be Apollo series 64, Watts series LFB6080, or approved equal.
- d. Stainless steel ball valves shall have a stainless steel body with stainless steel balls and Teflon (PTFE) seats. End connections shall be threaded and valves shall be of full-port design. Valves shall be rated for 300 psi WOG. Stainless steel ball valves shall be Apollo series 76F-100-A, Watts series S-FBV-1, or approved equal.

2.8 INSERTION VALVES

- a. Insertion valves shall be gate valves and have ductile iron or stainless steel body, bonnet, and gate. Gate shall be rubber coated, valve stems shall be stainless steel, gaskets shall be EDPM. Insertion valves shall be AVT EZ valves, Hydra-Stop Insta-Valve, or approved equal.
- b. Insertion valves shall be installed by an installer that is certified by the manufacturer.

2.9 VALVE BOXES

- a. All buried valves shall be provided with valve boxes. Valve boxes shall conform to Standard Details. Lid to read "Water" for water system valves.
- b. All parts of valve boxes and covers shall be coated by dipping in bituminous varnish.

2.10 PLUG VALVES

- a. Plug valves shall be full-port, non-lubricated eccentric plug valves. Plug valves shall be resilient faced plug style and include bi-directional eccentric seating so that the opening movement of the plug results in the plug rising off of the body seat contact.
- b. Rated working pressure shall be 175 psi (direct and reverse pressure) for 4" to 12" plug valves, and 150 psi (direct and reverse) for larger valves, and shall be designed for applications involving throttling service or frequent operation. Flanges, where required or shown on the drawings, shall be 125 pound, full faced, drilled per ANSI B16.1.
- c. All plug valves shall pass a drop tight pressure test at the specified shutoff pressure and pass a body hydrostatic test at 1.5 times the working pressure rating prior to shipment.
- d. Valve bodies and plugs shall be ASTM A126 Class B cast iron. Bodies in 4-inch and larger valves shall be furnished with a 1/8-inch welded stainless steel or nickel overlay seat. The seat area shall be raised, with the raised surface completely covered with weld to insure that the plug face contacts only stainless steel or nickel. Screwed in seats shall not be acceptable.
- e. The interference between the plug face and the body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure. The plug shall be resilient faced with a Buna N, hycar or equivalent compound suitable for use with sewage, bonded to insure a permanent coating.
- f. Valves shall have sleeve type metal bearings and shall be of sintered, oil impregnated permanently lubricated Type 316 steel. Valve shaft seals shall be of the multiple V-ring type and shall be externally adjustable and repackable under pressure without removing the bonnet from the valve. Non-metallic bearing or valves with O-ring or non-adjustable packing shall not be acceptable.
- g. All valves shall be provided with worm gear actuators and either square nuts or handwheels. All gearing shall be enclosed in a steel housing with seals provided on all shafts to prevent entry of dirt or water into the actuator, rated for submergence. The exposed shaft shall be stainless steel. All exposed nuts, bolts and washers shall be galvanized or stainless steel. For valves provided with a 2-inch square operating nut, the nuts shall have a flanged base on which shall be cast an arrow at least 2-inch long with the word "OPEN" cast on the nut to clearly indicate the direction of opening. All actuators shall be provided with externally adjustable open and closed stops. All buried plug valves shall be provided with 2-inch AWWA operating nut and stem extensions.

- h. Unless otherwise specified, all valves shall be furnished with a fusion-bonded epoxy coating inside and outside conforming to the requirements of AWWA C-550.
- i. Valve actuators shall be mounted such that the plug shaft is horizontal and the plug is up when open, with the square nut oriented upward. For horizontal installations, the valve shall be configured for installation with flow entering the seat end of the valve (ie. seat end toward the pump).

2.11 HOSE BIBS.

- a. Hose bibs for washdown stations shall be ¾" brass female NTP threaded inlet by male hose threads. Hose bibs shall be Nibco Husky No-Kink Hose Bibbs model 55, or approved equal.

2.12 PRESSURE GAUGE ASSEMBLIES

- a. Where shown on the drawings, furnish and install pressure gauge assemblies conforming to the drawing details including stainless steel pipe nipples and fittings, stainless steel ball valves and pressure gauges. Whether shown on the drawings or not, pressure gauge assemblies shall include diaphragm seals to separate the process fluid from the gauge.
- b. The pressure gauge(s) shall have pressure ranges noted below. Any other gauge not noted below shall have a pressure range of 0-160 psi unless noted otherwise on the drawings. Unless otherwise specified, pressure gauge(s) shall be bottom mount 3½" dial face, 1% accuracy, liquid filled Ashcroft 1009 or approved equivalent.
 - 1) Irrigation Pump Gauges: 0-160 psi
 - 2) DAF Pump Gauges: 0-60 psi
 - 3) Plant Pump Station Gauges: 0-100 psi
 - 4) WAS Pump Gauges: 0-30 psi
- c. Diaphragm seals shall be stainless steel for the specific service involved. Seals shall have threaded end connections. The gauges and seals shall be assembled and oil filled at the factory prior to shipment to the jobsite. Diaphragm seals shall be Trerice, Ashcroft Type 100 or approved equal.
- d. Where shown on the drawings mini ball valves shall be used for the pressure gauge assemblies to minimize the size of the assemblies. Mini ball valves shall be 316 stainless steel, rated for 1000 psi.

2.13 DUCKBILL CHECKVALVES

- a. Duckbill check valves shall consist of an elastomeric duckbill with a piping connection. Piping connections shall be as shown on the drawings. All metallic components of the valve including mounting hardware shall be stainless steel. Valves shall be as manufactured by Tideflex Technologies, or approved equal.

2.14 FROST PROOF YARD HYDRANTS

- a. Yard hydrants shall be lever operated and designed to provide a variable flow from a trickle to full flow, and shall have standard ¾-inch hose thread outlet with non-removable vacuum breakers. Yard hydrants shall be capable of being padlocked in the off position.
- b. Yard hydrants shall be provided with a cast iron head and a stainless steel operating rod. Brass operating rods are not acceptable. The barrel of the hydrant shall be 1-inch diameter galvanized pipe. Yard hydrants shall be Merrill Model C-1000 or approved equivalent.

2.15 FIRE HYDRANTS

- a. See drawing details for hydrant specifications.

2.16 SOLENOID VALVES

- a. Solenoid valves, with manual override, shall be installed at the locations shown on the drawings. The solenoid valve shall be ASCO, series #8210 with manual override. Valve size shall be 1-inch.

2.17 WASTEWATER COMBINATION AIR RELEASE/VACUUM VALVES

- a. Combination air release/vacuum valves shall be furnished and installed in the Irrigation and DAF pump station pump discharge piping as shown on the plans.
- b. The combination air release and air and vacuum valve shall be specifically designed for sewage. The combination air valve shall be A.R.I. D-020 SS, specially designed to operate with liquids carrying solid particles.
- c. The valve connection size and configuration shall be as shown on the drawings.
- d. The combination air valve shall have a conical shaped body with a cam lock back flushing attachment as part of the working mechanism. The valve shall be equipped with a stainless steel float that is spring loaded to allow for system vibrations and turbulence.
- e. The valve operating mechanisms shall be non-metallic and corrosion resistant. The valve working pressure shall be 250 psi.
- f. The valve shall be of the type that releases large amounts of air, gases and vapor during the filling of the system and admits large amounts of air when the system drains to prevent vacuum damage to pipeline and accessories.
- g. The valve shall release accumulated air from the system while the system operates under pressure, while maintaining an air pocket separation between the liquid and the working mechanism. The air release orifice shall be 0.0186 inch² and shall be an integral extension of the air and vacuum orifice, which shall be rectangular in shape.

2.18 PRESSURE REDUCING VALVE

- a. Pressure reducing valves shall be Appollo Series 36, or equal. Size and operating pressure as noted on the drawings.

2.19 BACKFLOW PREVENTION DEVICE

- a. As specified on the drawing details.

PART 3: EXECUTION

3.1 INSTALLATION

- a. Valves shall be installed in accordance with AWWA standards or in accordance with the manufacturer's recommendations. Alignment and adjustments shall be verified after installation. Tee wrenches and operators shall perform freely, without binding or other interferences.
- b. Valves shall be cleaned and Contractor shall touch up all previously primed surfaces to repair damages. Contractor shall make visual check of operating parts for proper and satisfactory operation.
- c. Buried valves shall be installed in a vertical position and be provided with a valve box in accordance with the drawing details. The valve boxes shall be set to position during backfilling operations so they will be in a vertical alignment to the valve operating gear shaft. The lower casting of the unit shall be installed first in such a manner as to be cushioned and to not bear directly upon the body of the valve or upon the pipe. The upper casting of the unit shall then be placed in proper alignment at such an elevation that its top will be at final grade.
- d. Plug valves shall, wherever possible, be installed with the stem horizontal and in such a manner that the plug is up when open, with the square nut (or handwheel) oriented upward. For horizontal installations, the valve shall be configured for installation with flow entering the seat end of the valve. The purpose of this is to prevent wiping grit across the valve seat upon opening.
- e. Plug valves: For sewage service the valve shall be installed so that the flat portion faces upstream thus preventing buildup of sludge or other particles inside the valve.
- f. Buried valves shall be bedded and backfilled according to the requirements of the pipe that they are attached to and Section 02226.

3.2 INSERTION VALVES

- a. Insertion valves shall be installed by installers that are certified and authorized by the valve manufacturer.

3.3 TESTING

- a. The Contractor shall furnish all equipment, material and labor to perform the required tests. Defects that become evident during the tests shall be corrected by the Contractor at his own expense. The Contractor shall notify the Engineer prior to performing tests.
 - 1) Valves shall be tested and proven satisfactory with the pipeline they are attached to and at the pipeline pressure specified in the respective pipe sections herein. In addition to the pressure test, all valves shall be given an operational test by completely opening and closing the valve satisfactorily a minimum of 4 cycles against the maximum differential of pipeline test pressure required on one side and 0 pressure on the other side of the valve.
 - 2) Records shall be maintained by the Contractor of tests indicating date of test, item tested, test pressure passed, and inspector's name. Test reports shall be promptly submitted to the Engineer.

3.4 PAINTING

- a. All exposed and submerged ferrous and plastic surfaces shall be shop primed and finish painted in accordance with Section 09900.

3.5 CERTIFICATION TESTING OF BACKFLOW DEVICES

- a. Following pressure testing and disinfection, the Contractor shall have all backflow devices tested by a state certified backflow tester, and provide written copies to the Owner's Representative.

SECTION 15200
PROCESS PIPING INSULATION

PART 1: GENERAL

1.1 SCOPE

- a. The exposed, above-grade, sections of the 6 inch sludge piping mounted on the bridge over Beaver Creek and the exposed, above-grade, section of the 4 inch plant pump station forcemain piping entering the headworks shall be heat traced and insulated. The specifications for the heat tracing are included in Division 16 and the specifications for the insulation are included herein.

1.2 RELATED SECTIONS

- a. Section 16128 - Electric Pipe Tracing

1.3 SUBMITTALS

- a. Action Submittals: Manufacturer's descriptive literature.
- b. Informational Submittals: Maintenance information.

PART 2: PRODUCTS

2.1 PIPE INSULATION

- a. Type 3 – Foamglass:
 - 1) Material: Cellular glass per ASTM C552.
 - 2) Nominal Density: 7.5 pcf.
 - 3) Compressive strength: 90psi per ASTM C165.
 - 4) Temperature Rating: Minus 290 to 900 degrees F.
 - 5) Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.29 Btu-in/hr-square foot degrees F.
 - 6) Minimum water vapor transmission for insulation of 0.00 perm-inch per ASTM E96.
 - 7) Joints: Matching pressure-sensitive butt strips for sealing circumferential joints.
 - 8) Flame Spread Rating: 0 per ASTM E84.
 - 9) Smoke Developed Index: 0 per ASTM E84.
 - 10) Follow manufacturer's recommendation, based upon temperature of piping to be insulated,
 - 11) Manufacturer and Product: Pittsburgh Corning; Foamglass.

2.2 FITTING INSULATION

- a. Type 3: Same as pipe.

2.3 INSULATION FINISH SYSTEMS

- a. Type F3 – Aluminum;
 - 1) Aluminum Roll Jacketing: For straight run piping, wrought aluminum Alloy 3003, 5005, 1100, or 3105 to ASTM B209 with H-14 temper, minimum 0.016 inch thickness, with smooth mill finish.
 - 2) Vapor Barrier: Provide factory applied vapor barrier, consisting of 40-pound kraft paper with 1-mil thick low density polyethylene film, heat and pressure bonded to inner surface of aluminum jacketing.
 - 3) Fitting Covers: Material as for aluminum roll jacketing, premolded, one or two piece covers, which includes elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings.
 - 4) Manufacturers:
 - a) RPR Products, Insul-Mate
 - b) Childers
 - c) Pabco

PART 3: EXECUTION

3.1 APPLICATION

- a. General
 - 1) Insulate valve bodies, flanges, and pipe couplings.
 - 2) Insulate and vapor seal hangers, supports, anchors, and other popping appurtenances that are secured directly to cold surfaces.
 - 3) Do not insulate flexible pipe couplings and expansion joints.
 - 4) Service and Insulation Thickness: Fluid temperature 40-75 degrees F, minimum insulation thickness 2 inches.
 - 5) All insulation installed on piping outside shall be provided with aluminum jacketing.

3.2 INSTALLATION

- a. General:
 - 1) Install in accordance with manufacturer's instructions and as specified herein.
 - 2) Install insulation after piping system has been pressure tested and leaks corrected.
 - 3) Apply insulation over clean dry surfaces.
 - 4) Do not allow insulation to cover nameplates or code inspection stamps.
 - 5) Run insulation or insulation inserts continuously through pipe hangers and supports, wall openings, ceiling openings, and pipe sleeves, unless otherwise shown.
 - 6) Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
 - 7) Use Insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
- b. Placement
 - 1) Slip insulation on pipe or tubing before assembly when practical to avoid longitudinal seams.

- 2) Insulate valves and fittings with sleeved or cut pieces of same material
 - 3) Seal and tape joints.
- c. Insulation at Hangers and Supports: Insulation or insulation inserts to be continuous through hanger or support.
- d. Heat Traced Piping: Apply insulation after heat-tracing work is completed and inspected.
- e. Aluminum Jacket:
 - 1) Use continuous friction type joint to hold jacket in place, providing positive weatherproof seal over entire length of jacket.
 - 2) Secure circumferential joints with preformed snap straps containing weatherproof sealant.
 - 3) On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
 - 4) Do not use screws or rivets to fasten the fitting covers.
 - 5) Install removable prefabricated aluminum covers on exterior flanges and unions.
 - 6) Caulk and seal exterior joint to make watertight.

3.3 FIELD FINISHING

- a. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.
- b. Where pipe labels or banding are specified for a piping system they shall be applied to the finished insulation and not to the pipe.
- c. Painting Piping Insulation (Exposed to View): Metal or PVC jacketing do not require painting.

PART 4: SPECIAL PROVISIONS

None.

DIVISION 16

ELECTRICAL

As noted in the specification submittal requirements, Contractor shall provide all of the electrical / control / telemetry / SCADA product data in Division 13 & Division 16 at the same time, unless specifically allowed otherwise in writing by the Owner's project electrical engineer. Piecemeal submittals will be returned as incomplete.

Circuit Breaker Coordination.

The preliminary circuit breaker (*protective device*) coordination is based on the specific brand of circuit breakers specified and/or noted on the drawings as the basis-of-design (*ie. all circuit breakers used on the project shall be products of the same manufacturer, to allow for the Code required protective device coordination*). If any circuit breakers and/or protective devices provided are different from those specified and/or noted on the drawings, the general contractor shall be responsible for providing any and all coordination studies and analysis' as specified or required by Code.

In addition, if any circuit breakers and/or protective devices provided are different from those specified and/or noted on the Drawings, the general contractor shall be responsible for verifying that the dimensions of the enclosures, panels, and switchgear that house the protective devices of the alternate manufacturer do not exceed the dimensional footprint and Code required working clearances of the basis-of-design manufacturer's enclosures, panels and switchgear shown on the Drawings.

SECTION 16001 COMMISSIONING

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) Definitions
 - 2) Requirements for commissioning.

1.2 DEFINITIONS

- a. Commissioning Verification Period.
 - 1) The commissioning period begins after the ENGINEER has approved the Functional Test Certification demonstration with the control software, the specified demonstration and training is complete, punch list deficiencies are corrected and the final operation and maintenance manuals are submitted and approved. The duration of the commissioning verification period is 14 days without significant interruption.
- b. Significant Interruption.
 - 1) Significant interruption may include any of the following events.
 - a) Failure of the CONTRACTOR to maintain qualified onsite start-up personnel as specified.
 - b) Failure of critical equipment unit, system, or sub-system that is not satisfactorily corrected within two (2) hours after the failure.
 - c) Failure of noncritical equipment unit, system, or sub-system that is not satisfactorily corrected within twenty-four (24) hours after the failure.
 - d) As may be determined by the ENGINEER.

1.3 REQUIREMENTS FOR COMMISSIONING

- a. Commissioning of the facility shall be completed prior to substantial completion.
- b. CONTRACTOR shall provide for realistic durations in the progress schedule for the commissioning activities.
- c. Provide the labor, medium, chemicals, tools, equipment, instruments and services required for, and incidental to, completing commissioning.
- d. Demonstrate satisfactory operation within the facility of the equipment and systems in actual operation as a functional unit.
- e. Conduct commissioning for a period of fourteen (14) continuous days without significant interruption.

- f. The commissioning verification period shall restart with the correction of each significant interruption.
- g. Correct defects in material and workmanship immediately following their discovery.
- h. Provide for maintenance until substantial completion. This includes the required maintenance activities during the commissioning verification period.
- i. Perform maintenance pursuant to the operation and maintenance data requirements for the new facility during and following the commissioning verification period and prior to issuance of a certificate of substantial completion.
- j. As of the date of substantial completion, OWNER's staff shall be responsible for operation and maintenance of the new facilities. This excludes any issues identified as warranty matters.

PART 2: PRODUCTS – NOT USED

PART 3: EXECUTION – NOT USED

END OF SECTION

SECTION 16005
STARTING AND ADJUSTING

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) Definitions.
 - 2) Sequence of start-up activities.
 - 3) General requirements.
 - 4) Manufacturer's representative responsibilities.
 - 5) CONTRACTOR's independent process control test certification verification.
 - 6) CONTRACTOR's demonstration of the process control test certification to the ENGINEER.
 - 7) CONTRACTOR's independent functional test certification verification.
 - 8) CONTRACTOR's demonstration of the functional test certification to the ENGINEER.
 - 9) Record keeping.
 - 10) Supplements.

1.2 DEFINITIONS

- a. Manufacturer's Representative – Authorized service division employee of the manufacturer.

1.3 SEQUENCE OF START-UP ACTIVITIES

- a. Develop a specific plan for testing and start-up activities required for the project and submit to the ENGINEER for approval no less than 21 days before the initial start-up of equipment begins. The plan shall, as a minimum, incorporate the activities itemized below.
 - 1) Complete all work associated with the installations of the unit and related processes before start-up activities begin.
 - 2) Manufacturer's representative shall certify the installation meets manufacturer's recommendations and instructions.
 - 3) Manufacturer's representative shall certify equipment operates as specified and as shown in the Contract Documents.

- 4) Calibrate instruments.
- 5) CONTRACTOR's independent process control test certification verification.
- 6) CONTRACTOR's demonstration of the process control test certification to the ENGINEER. Operation and maintenance manuals shall be available during this activity.
- 7) CONTRACTOR's independent functional test certification verification.
- 8) CONTRACTOR's demonstration of the functional test certification to the ENGINEER.
- 9) Submit records kept during start-up and adjusting activities.
- 10) Commissioning activities described in Section 16001 – Commissioning.
- 11) Demonstration and training described in Section 16015 – Demonstration and Training.
- 12) CONTRACTOR shall provide sufficient time in the progress schedule to accommodate the start-up sequences.

1.4 GENERAL REQUIREMENTS

- a. All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
- b. Demonstrate proper function of all equipment, systems and control devices.
- c. Furnish labor, process medium, chemicals, tools, equipment, instruments, and services required for, and incidental to, completing start-up and adjusting activities.
- d. Manufacturer's representative shall provide assistance for assembly and installation as well as testing guidance and troubleshooting during the start-up and adjusting activities.
- e. Complete Supplement 16005-A, "Process Control Test Certification" and submit the completed form to the ENGINEER for approval. The submission and approval of this form is required prior to commencing with the CONTRACTOR's demonstration to the ENGINEER that each process itemized in the Process Control Test Certification operates as specified and designed.
- f. Complete the following mechanical adjustments prior to, or during, the CONTRACTOR's initial start-up and adjusting activities and before demonstration to the ENGINEER.
 - 1) Remove rust preventatives and oils applied to protect equipment during construction.

- 2) Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.
 - 3) Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
 - 4) Remove temporary supports, bracing and other foreign objects installed to prevent damage during shipment, storage and erection.
 - 5) Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
 - 6) Perform cold alignment and hot alignment to manufacturer's tolerances.
 - 7) Adjust belt tension and variable pitch sheaves.
 - 8) Inspect hand and motorized valves for proper adjustment. Tighten packing glands to insure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.
 - 9) Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
 - 10) Install gratings, safety chains, handrails, shaft guards and sidewalks prior to operational testing.
- g. Complete the following electrical and control adjustments prior to, or during, the CONTRACTOR's initial start-up and adjusting activities and before demonstration to the ENGINEER.
- 1) Perform insulation resistance tests on all conductors operating at or above 200 volts.
 - 2) Perform continuity tests on all conductors.
 - 3) Test and set circuit breaker relays and circuit breaker trip settings for proper operation. Coordinate the trip settings for all circuit breakers.
 - 4) Check and record motors for actual full load amperage draw on each phase and compare to nameplate value. Submit results to ENGINEER.
- h. Complete the following instrumentation adjustments prior to, or during, the CONTRACTOR's initial start-up and adjusting activities and before demonstration to the ENGINEER.
- 1) Field calibrate instruments and make required adjustments and control point settings.
 - 2) Leak test pneumatic controls and instrument air piping.

- 3) Energize transmitting and control signal systems, verify proper operations, ranges and settings.

1.5 MANUFACTURER'S REPRESENTATIVE RESPONSIBILITIES

- a. Manufacturer's representative shall inspect the installation and certify with a written report that the installation meets the requirements of the Contract Documents as well as the Manufacturer's recommendations. This shall be done before the equipment is energized.
- b. At completion of a manufacturer's representatives' start-up and testing activities, they each shall furnish a written report certifying the equipment installation meets the following conditions.
 - 1) Has been properly installed to meet the IBC seismic requirements and has been adjusted, aligned and lubricated as required.
 - 2) Is free of any stresses imposed by connecting piping or anchor bolts.
 - 3) Is suitable for satisfactory full time operation under full load conditions.
 - 4) Operates within the allowable limits for vibration.
 - 5) Controls, protective devices, instrumentation and control panels furnished as part of the equipment package are properly installed, calibrated and functioning.
 - 6) Control logic for start-up, shutdown, sequencing, interlocks and emergency shutdowns have been tested and are functioning properly.

1.6 CONTRACTOR'S INDEPENDENT PROCESS CONTROL TEST CERTIFICATION VERIFICATION

- a. Verify the equipment provided is installed correctly and functions properly.
- b. Complete Supplement 16005-A, "Process Control Test Certification" pursuant to the following.
 - 1) The supplement is not intended as a replacement for a systematic check of all the requirements specified.
 - 2) Complete the tests outlined in the Supplement, fill out the form and sign it certifying that the tests have been successfully performed and the results recorded.
 - 3) Where it is not possible to test a function without the software furnished, the CONTRACTOR shall verify the inputs/outputs (I/O's) are terminated correctly by simulating the process as closely and to the extent possible and checking the I/O terminations for voltage and continuity.

- c. Submission of the completed Supplement to the ENGINEER and approval of the submission are a prerequisite to the CONTRACTOR's demonstration of process control test certification to the ENGINEER.

1.7 CONTRACTOR'S DEMONSTRATION OF PROCESS CONTROL TEST CERTIFICATION TO THE ENGINEER

- a. The intent of the demonstration of the operation to the ENGINEER is to ascertain the installation, including the hardwired control, are in compliance with the Contract Documents. Successful completion of this step will facilitate efficient demonstration of the complete operations of the facilities when the configured control software is installed and tested as part of the Functional Test Certification.
- b. Demonstrate compliance with the items listed in Supplement 16005-A.
- c. ENGINEER may require the CONTRACTOR to demonstrate functions or processes in addition to those itemized in Supplement 16005-A.
- d. ENGINEER's approval of the demonstration of the process control test certification is required before the Functional Test Certification phase commences.

1.8 CONTRACTOR'S INDEPENDENT FUNCTIONAL TEST CERTIFICATION VERIFICATION

- a. Complete Supplement 16005-B, "Functional Test Certification" pursuant to the following.
 - 1) Complete the tests outlined in the Supplement, fill out the form and sign it certifying that the tests have been successfully performed and the results recorded.
 - 2) This test will be conducted with the configured software installed and functional. Alarms, data logging, trending and control functions shall be verified
- b. Submission of the completed Supplement to the ENGINEER and approval of the submission are a prerequisite to the CONTRACTOR's demonstration of functional test certification to the ENGINEER.

1.9 CONTRACTOR'S DEMONSTRATION OF THE FUNCTIONAL TEST CERTIFICATION TO THE ENGINEER

- a. The intent of the demonstration of the Functional Test Certification to the ENGINEER is to ascertain the installation, including the configured software program, is in compliance with the Contract Documents.
- b. Demonstrate items listed in Supplement 16005-B, "Functional Test Certification" to the ENGINEER.
- c. ENGINEER may require the CONTRACTOR to demonstrate functions or processes in addition to those itemized in Supplement 16005-B.

- d. ENGINEER's approval of the demonstration of the Functional Test Certification is a prerequisite to beginning the commissioning phase.

1.10 RECORD KEEPING

- a. CONTRACTOR shall maintain, as a minimum, the following records generated during the start-up and adjusting activities.
 - 1) Daily logs of equipment and process testing, identifying all tests conducted and a summary of the results.
 - 2) Logs of time spent with manufacturer's representatives providing services for the project.
 - 3) Equipment lubrication records.
 - 4) Electrical phase voltage and amperage measurements for all equipment.
 - 5) Insulation resistance measurements.
 - 6) All completed test forms specified in Section 16080 Electrical Testing.

PART 2: PRODUCTS – NOT USED

PART 3: EXECUTION

3.1 SUPPLEMENTS

- a. Supplement 16005-A, "Aumsville WWTP Process Control Test Certification".
- b. Supplement 16005-B, "Aumsville WWTP Functional Test Certification".

END OF SECTION

SUPPLEMENT 16005-A
Aumsville WWTP
Process Control Test Certification

#	Description	Pass	Fail	Comments
1	Start-up & test plan submitted ≥ 21 days prior to initial start-up; includes scope, sequence, responsibilities, safety, forms			
2	Latest approved drawings/docs onsite: P&IDs, one-lines, wiring diagrams, loop sheets, I/O list, network diagram, control narrative, interlock matrix			
3	O&M manuals and vendor IOMs available onsite during demonstration			
4	All installation work complete for system under test (mechanical install, power, grounding, conduits, terminations, labeling) prior to start-up activities			
5	LOTO plan in place; energized testing plan/PPE per NFPA 70E as applicable			
6	Panel labeling complete: nameplates, circuit IDs, wire labels, terminal block labels, I/O point labels match drawings			
7	Field device labeling complete: equipment/instrument tags, cable IDs, JB labels, conduit IDs match loop sheets			
8	MCC/VFD/starter labeling complete: load served, feeder ID, HOA/Local-Remote identification, E-Stop labels			
9	Network labeling complete: switch IDs, port labels, patch panel labels, drop labels match network diagram			
10	Insulation resistance (megger) tests completed on all ≥ 200 V conductors; results recorded			
11	Continuity tests completed on all conductors; results recorded			
12	Breakers/protective devices tested; trip/relay settings documented and coordinated per design intent			
13	Control power verified: 120 VAC and/or 24 VDC present at required panels; polarity/ground reference correct; loading within power supply rating			
14	Grounding/bonding verified: equipment bonding jumpers installed; panel/field device bonding complete; shields terminated per standard			
15	Motor rotation verified (bump test) prior to full run; direction correct			
16	Motor run current measured per phase (where safely possible); compare to nameplate FLA; record and submit results			
17	Each instrument field-calibrated as applicable; as-found/as-left documented			

#	Description	Pass	Fail	Comments
18	Signal types verified at terminals per point: dry contact, 4–20 mA, pulse, RTD/TC, 0–10 V, HART, etc.			
19	Analog loop power verified (24 VDC loop supplies/isolators as applicable); polarity correct			
20	Pneumatic instrument air leak test completed (if applicable); regulators set; leaks corrected			
21	Transmitting/control signal systems energized; verify stability, noise immunity, and correct range			
22	Device installed at correct location and matches specified model/options/rating (NEMA, hazardous area rating if applicable)			
23	Correct cable type/pair count/shielding installed per loop sheet; routing and separation compliant (power vs signal)			
24	Terminations verified at both ends (field/JB/panel); terminal numbers match drawings; terminations torqued			
25	DI point-to-point: simulate contact open/close; verify correct PLC input/state at terminal and controller			
26	DO point-to-point: command output/test; verify correct voltage at terminal and correct field action (relay/solenoid/starter enable)			
27	AI point-to-point: inject simulated signal; verify correct raw value and engineering units; scaling direction correct			
28	AO point-to-point: command simulated output or measure at terminal; verify correct current/voltage and correct field response where possible			
29	Pulse input verification: simulate pulse rate; verify counts/totalizer increment correctly			
30	Intrinsic safety barriers/isolators (if used) installed and wired correctly; powered where required; polarity verified			
31	E-Stop function test: each E-Stop removes power/enable to intended equipment; verify any required status feedback to PLC			
32	Overload trip function test: overload trips inhibit run; trip contact wired to PLC if required			
33	Local disconnect aux-contact (if provided/required) inhibits run permissive; status feedback verified if required			
34	HOA / Local-Remote selector test: each position performs required control mode; selector status feedback verified if provided			
35	VFD interface checks: run/enable chain proven; fault relay wired and proven; speed reference wiring type verified (AI/comms)			

#	Description	Pass	Fail	Comments
36	Valve/damper actuator checks: Local/Off/Remote works; open/close commands actuate; end switches/position proof contacts land correctly; fail position confirmed			
37	Level switch/float checks: simulate each level (LL/L/H/HH); verify correct PLC input and hardwired permissive/alarm behavior as designed			
38	Pressure/flow switch checks: simulate trip/restore; verify correct PLC input and permissive/alarm behavior			
39	Gas detection / safety alarm relay checks (if applicable): alarm/fault relays wired correctly; fail-safe philosophy verified; PLC alarm inputs proven			
40	Packaged equipment interface checks: run status and common alarm contacts wired and proven at both vendor panel and main PLC terminals			
41	Vendor package interface list confirmed (status, alarms, analogs, starts/permissions if any) and matches installed wiring/terminations			
42	Communications interface (if used) physical layer verified: cable type, terminations, switch port, link status, addressing plan			
43	Communications basic health verified (as applicable): device reachable, session established, data points readable (pre-functional)			
44	Local control stations (start/stop/pilot lights) proven where provided; do not bypass required safeties			
45	Solenoids/actuators stroke correct direction; proper response without sticking; correct fail-open/fail-closed confirmed			
46	Mechanical readiness confirmed before operational testing: guards/gratings/handrails installed; temporary shipping braces removed; lubrication/flush completed where applicable			
47	Daily test logs maintained: tests performed, results, deficiencies, corrective actions, retest dates			
48	Manufacturer representative visit log maintained (time onsite, scope, reports received)			
49	Manufacturer representative written installation/start-up report received (installation meets contract + manufacturer requirements; controls/protective devices installed/calibrated; interlocks proven)			
50	Lubrication records maintained for equipment started/adjusted (where applicable)			
51	Electrical phase voltage and amperage measurements recorded for equipment tested			
52	Insulation resistance results filed with circuit/equipment identifiers and test voltages			

#	Description	Pass	Fail	Comments
53	Continuity test results filed with circuit/equipment identifiers			
54	All required Section 16080 electrical test forms completed and included in turnover package			

END OF SUPPLEMENT

SUPPLEMENT 16005-B
Aumsville WWTP
Functional Test Certification

#	Description	Pass	Fail	Comments
1	Configured control software installed and correct version verified (PLC, HMI/SCADA, VFD parameters, vendor package PLC programs as applicable)			
2	Final approved control narrative, cause & effect, and interlock matrix available onsite and matches programmed logic			
3	Final approved I/O database and tag naming conventions loaded (PLC/HMI/SCADA)			
4	All previously identified deficiencies from Process Control Test Certification closed (or documented as accepted exceptions)			
5	Operator accounts/roles created; privilege levels verified (admin/maint/operator/view-only)			
6	Time sync configured and verified for all PLCs/HMIs/servers (NTP or equivalent); timestamps consistent			
7	SCADA/PLC communications verified stable (no dropouts); network health checked (ports/VLANs/IPs as applicable)			
8	Remote access (if provided) configured and tested per Owner IT/security requirements			
9	UPS/backup power for controls/SCADA (if provided) tested for ride-through; proper shutdown behavior verified			
10	All analog inputs scaled correctly in software (EU, range, decimals, filter/damping, failsafe values)			
11	All analog outputs scaled correctly in software (EU mapping, min/max clamps, bumpless transfer behavior)			
12	All digital input states verified correct normal/alarm logic (NO/NC, energized/de-energized) in HMI/SCADA indications			
13	All digital outputs verified correct action and correct permissive logic in software (including seal-in/run command logic)			
14	All totalizers/counters configured correctly (units, scaling, rollover, retention through power cycle)			
15	All PID loops configured per design intent (mode, direction, P/I/D values initial, output limits, anti-windup, rate limits)			
16	Manual/Auto/Off modes implemented per design intent; transitions are bumpless (no spikes)			

#	Description	Pass	Fail	Comments
17	HOA/Local-Remote interactions verified (local mode overrides remote commands; SCADA displays correct status and control availability)			
18	Start permissives and stop causes displayed clearly on HMI (permissive not satisfied, trip, fault, interlock)			
19	Interlock bypasses (if allowed) are password-protected, alarmed, time-limited, and logged; default state is bypass disabled			
20	Alarms configured for all required points (HI/HH/LO/LL, deviation, rate-of-change where required)			
21	Alarm setpoints match approved documents; deadbands and delays set to prevent nuisance alarms			
22	Alarm priorities configured (critical/major/minor/advisory) per Owner standard			
23	Alarm annunciation verified (banner, audible, horn silence, acknowledge, reset behavior)			
24	Alarm shelving/suppression behavior verified (if provided) with audit trail/logging			
25	Alarm logging verified: alarms record tag, timestamp, value, operator, acknowledge time, return-to-normal time			
26	Alarm fail-safe verified: loss of signal, comms failure, device fault produces correct alarm and safe control response			
27	Trends configured for key process variables and equipment states (PV, SP, OUT, mode, run/fault)			
28	Trend sampling rates appropriate (fast for control loops, slower for process); storage retention verified			
29	Historian/data logging configured for required parameters; data integrity verified across power cycle			
30	Reports/dashboards (if specified) generated correctly (daily flow, runtime, chemical usage, alarms summary)			
31	Sequence logic verified for each operating mode (AUTO, MANUAL, LOCAL) per control narrative			
32	Equipment start/stop sequences verified (pre-start checks, delays, staged starts, post-run purge/cooldown as applicable)			
33	Interlocks verified with live simulation or controlled field conditions (level/pressure/flow/valve position/gas alarm)			
34	Fail-safe behavior verified for each critical device on loss of signal/comms/power (defined safe state achieved)			

#	Description	Pass	Fail	Comments
35	Restart behavior verified after power loss (defined "power-up state," no unexpected auto-starts unless specified)			
36	Remote start permissives verified (no starts with E-Stop active, overload tripped, local mode selected, disconnect open if monitored)			
37	Process permissives verified (e.g., pumps require min level, valves proven, air supply available, etc.)			
38	Lead/lag logic verified where applicable (alternation schedule, runtime balance, failover on fault)			
39	Duty/standby failover verified (auto transfer to standby on duty failure with alarm)			
40	Runtime meters and starts counters increment correctly and persist through power cycles			
41	Maintenance inhibit/out-of-service function verified (prevents auto starts; annunciates status)			
42	VFD controls verified: HOA, speed reference source, min/max speed limits, accel/decel times, skip frequencies if required			
43	VFD protective functions verified: fault detection, auto-reset (if allowed), fault annunciation, safe stop behavior			
44	Motor thermal/overload integration verified: trip response, reset behavior, alarm indication			
45	Soft starters (if any) settings verified and starts tested under expected load			
46	Control valve logic verified: open/close commands, position feedback scaling, end-switch proofs, timeout alarms			
47	Modulating valve control verified: positioner response, scaling, fail position, stroking test, deadband			
48	Motorized dampers/louvers verified: interlocks, proof-of-open, start delays, failure alarms			
49	Chemical feed system controls verified (if applicable): permissives, flow-paced logic, interlocks, low-chem alarms, containment leak alarms			
50	Sampler controls verified (if applicable): flow-proportional pacing, bottle full/door open alarms, remote start/stop, status indication			
51	Instrument validation under process conditions: PVs track expected physical values and respond correctly to changes			
52	Instrument diagnostics verified: fault bits, sensor health, maintenance alerts displayed and alarmed as required			

#	Description	Pass	Fail	Comments
53	Redundancy/validation logic verified where provided (e.g., two sensors voting, bad sensor detection)			
54	SCADA graphics verified: correct tag binding, correct units, correct normal states, correct navigation			
55	Faceplates verified: start/stop, mode control, SP entry limits, permissive/trip details, alarm access			
56	Setpoint/security limits verified (min/max clamps; admin-only where required)			
57	Operator prompts and messages verified (clear, actionable, not cryptic)			
58	Communications failure handling verified: comm loss alarms, frozen values flagged, control fallback behavior defined and tested			
59	Network equipment status monitored if specified (switch health, UPS status, server status)			
60	Integration with packaged vendor systems verified (SBR, DAF, etc.): all exchanged data points correct; command/handshake behavior correct			
61	Vendor package alarms mapped into plant SCADA with correct priorities and descriptions			
62	Vendor package mode/status indications correct and consistent with plant HMI conventions			
63	Commissioning safety checks completed: E-Stops, safeties, gas detection, ventilation interlocks (if applicable) verified do not get bypassed by software			
64	Emergency power behavior verified (if generator/ATS present): control system ride-through, alarm behavior, load shedding sequences if specified			
65	Lighting/egress/life safety interfaces (if any) verified per design intent (status points, alarms)			
66	Operator training completed on installed software: navigation, alarm response, basic troubleshooting, manual operation			
67	As-built documentation updated to match final configuration (I/O list, loop sheets, network diagram, control narrative redlines)			
68	Backups created and delivered: PLC program, HMI/SCADA project, VFD parameter sets, network device configs			
69	Spare parts and licenses delivered per contract (dongles, activation keys, media)			

END OF SUPPLEMENT

SECTION 16010
OPERATION AND MAINTENANCE DATA

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes:
 - 1) Definitions.
 - 2) General requirements.
 - 3) Submittal procedures.
 - 4) Content requirements for manuals.
 - 5) Supplements.

1.2 DEFINITIONS

- a. Maintenance Operation.
 - 1) Routine operation required to ensure satisfactory performance and longevity of the equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands and other routine adjustments.

1.3 GENERAL REQUIREMENTS

- a. Provide operation and maintenance data for items listed in Supplement 16010 – A, “Schedule of Equipment Requiring Operation and Maintenance Data”.
- b. In addition to the composite of manuals for individual equipment items or systems, provide a consolidated summary of required routine scheduled maintenance and scheduled preventative and predictive maintenance for the project, with reference to where detailed information may be found. Include safety information and emergency plans and procedures. The summary shall be in a separate binder from the other equipment and system binders.
- c. Comply with the following format relating to the Operation and Maintenance Manual:
 - 1) All binders shall be “D” ring type with one-touch ring locking mechanism.
 - 2) Overlay material shall be crystal clear poly.
 - 3) Binders shall be black poly.
 - 4) Binders shall be nominally sized for 75 percent fill per volume with a maximum binder depth of four (4) inches and a minimum depth of one (1) inch.
 - 5) Submit example binder cover sheet for approval by ENGINEER.

- 6) Submit example spine insert for approval by ENGINEER.
- 7) Paper: twenty (20) pound minimum, white for typed pages, 8.5 x 11 inches.
- 8) Text: Manufacturer's printed data, or neatly typewritten. Facsimiles transmitted via fax machine shall be unacceptable.
- 9) Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
- 10) Provide fly-leaf for each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment. Provide with heavy section dividers with numbered plastic index tabs.
- 11) Provide each manual with a title page, typed table of contents with consecutive page numbers. Plan contents of entire set, identified by volume number, in each binder.
- 12) Material shall be suitable for reproduction with quality equal to the original. Photocopying of material will be acceptable except for material containing photographs.
- 13) Table of contents shall be neatly typewritten, arranged in a systematic order, containing as a minimum the following data:
 - a) CONTRACTOR, name of responsible principle, address and telephone number.
 - b) List of each product required to be included and indexed to content of each volume.
 - c) List of each product, name, address and telephone number of subcontractor, supplier, installer and maintenance contractor as appropriate.
 - d) Provide local source and phone number of supply for parts and replacement.
 - e) Identify each product by product name, model number and other identifying numbers or symbols as set forth in the Contract Documents.
- 14) Product data:
 - a) Include only those sheets that are pertinent to the specific product provided.
 - b) Clearly annotate each sheet to identify specific product or part installed, data applicable to the installation and delete references to inapplicable information.
- 15) Drawings; supplement product data with drawings as necessary to clearly illustrate the following:
 - a) Relationship of component parts of equipment and systems.
 - b) Control and flow diagrams.
 - c) Coordinate drawings with project record documents to assure correct illustration of completed installations.

- d) CONTRACTOR shall not use project record documents as maintenance manual drawings.
- e) Provide reinforced punched binder tabs.
- f) Reduced 11 x 17 inch drawings shall be folded to 8.5 x 11 inch format.
- g) Where reduction to 11 x 17 inch is impractical, fold and place the 8.5 x 11 inch envelopes that are bound in the binder.
- h) Identify specification Section and product on drawings and envelopes.

1.4 SUBMITTAL PROCEDURE

- a. Compile the required data, arrange as specified herein and insert data in the number of volumes necessary. The volumes shall be submitted as a complete set. Partial or incomplete manuals shall be rejected by the ENGINEER.
- b. Preliminary Manuals:
 - 1) Submit three copies to ENGINEER for review and approval well before the starting and adjusting activities commence.
 - 2) If accepted:
 - a) One copy will be returned to the CONTRACTOR.
 - b) One copy will be forwarded to the OWNER.
 - c) One copy will be retained in the ENGINEER's file.
 - 3) If rejected:
 - a) Two copies will be returned to the CONTRACTOR with ENGINEER's comments for revision.
 - b) One copy will be retained in the ENGINEER's file.
 - c) CONTRACTOR shall be required to resubmit three revised preliminary manuals for ENGINEER's review.
- c. Final Manuals:
 - 1) Submit two copies to ENGINEER for review and approval before final completion.
 - 2) If accepted:
 - a) CONTRACTOR will be so notified.
 - b) CONTRACTOR shall provide a complete set of the final manual on CD-ROM. Data written specifically for the manual will be presented in MS Word format. Manufacturer data (per-printed data) will be presented in Adobe PDF format.
 - 3) If rejected:
 - a) At the ENGINEER's discretion either all but one copy of the manuals will be returned to the CONTRACTOR for revisions or all copies will be retained by the ENGINEER and the necessary revision data will be requested from the CONTRACTOR.

1.5 CONTENT REQUIREMENTS FOR MANUALS

- a. The Operation and Maintenance Manuals shall normally consist of no less than four volumes outline below.
- b. Volume 1 – Facility Overview.
 - 1) All sheets in volume 1 shall have sheet protectors.
 - 2) All materials in volume 1 shall be copied onto a CD and provided to the ENGINEER.
 - 3) Include instructions and procedures for handling, storage, maintenance during storage, assembly, erection, installation, adjusting, testing, operating, shut down in emergency, troubleshooting, maintenance, interface with other equipment and as may otherwise be required.
 - 4) Organize in a consistent format under separate heading for each different procedure.
 - 5) Provide a logical sequence of instructions for each procedure.
 - 6) Provide an information sheet for the OWNER's personnel which include the proper procedures in the event of a failure and instances that might affect the validity of warranties or bonds.
 - 7) Content for each unit (or common units) and system:
 - a) Description of unit and component parts including controls, accessories and appurtenances. Detail their function, normal operating characteristics and limiting conditions. Provide performance curves, engineering data, nameplates data and test forms. Provide a complete commercial number and nomenclature for replaceable parts.
 - 8) Operating Procedures:
 - a) Start-up and break-in routine and normal operating instructions.
 - b) Test procedures and results of factory tests where required.
 - c) Regulation, control, stopping and emergency instructions.
 - d) Description of operation sequence by control manufacturer.
 - e) Shutdown instructions for both short and extended durations.
 - f) Summer and winter operating instructions as applicable.
 - 9) Maintenance and Overhaul Procedures:
 - a) Routine operations
 - b) Guide to troubleshooting.
 - c) Disassembly, removal, repair, reinstallation and reassembly.
 - 10) Installation Instructions including alignment, adjusting, calibrating and checking.
 - 11) Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list and diagrams required for maintenance.
 - 12) Parts list by generic title and manufacturer's part number.

- 13) Name, location and telephone number of nearest supplier and spare parts warehouse.
- 14) Where applicable identify installed spares and other provisions for future work (e.g. reserved panel space, unused components, wiring and terminals).
- 15) Manufacturer's printed operating and maintenance instructions.
- 16) Charts of valve tag numbers along with the location and function of each valve.
- 17) Manufacturer's certifications including calibration data sheets and specified calibration procedures or methods for installed equipment.
- 18) Warranty forms and information for all installed equipment provided by the CONTRACTOR.
- 19) Circuit directories for all panels including electrical, control and communication.
- 20) List of adjustable electrical relay settings, control and alarm settings.

c. Volume 2 – Equipment Manuals.

- 1) Table of contents shall have a sheet protector
- 2) Table of contents and index sheets shall be of colored card stock.
- 3) Manuals for individual equipment shall not be divided between separate binders.
- 4) List function, normal operation, characteristics and limiting conditions.
- 5) Complete commercial part number and nomenclature of replaceable parts.
- 6) Maintenance procedures including routine operations, guide to troubleshooting and adjustments.
- 7) Manufacturer's printed operation and maintenance instructions.
- 8) List of manufacturer's spare parts and recommended quantities to be maintained in storage.
- 9) Contents for Maintenance Summary Manual:
 - a) Compile individual maintenance summaries for each applicable equipment item, respective unit or system and for components or subunits.
 - b) Format shall include use of the Supplement 16010 – B "Maintenance Summary" provided. Each Maintenance Summary may take as many pages as required. Supplement shall be typewritten and shall include detailed lubrication instructions and diagrams showing points to be greased or oiled, recommended type, grade and temperature range of lubricants and frequency of lubrication.

- c) Include a list and quantity of manufacturer's recommended consumable and spare parts that should be stored on site.
- d. Volume 3 – Drawings
 - 1) As-built drawings associated with the project shall be provided. This includes, but is not limited to, manufacturers supplied drawings. All drawings shall be provided on 11 x 17 inch sheets folded to 8.5 x 11 inch size and bound in this volume. A complete and detailed index shall be provided that includes a list of all drawings in the volume and the drawings shall be tabbed in a fashion that provides clear and concise identification.

PART 2: PRODUCTS – NOT USED

PART 3: EXECUTION

3.1 SUPPLEMENTS

- a. Supplement 16010 – A, “Schedule of Equipment Requiring Operation and Maintenance Data”.
- b. Supplement 16010 – B, “Maintenance Summary Form”.

END OF SECTION

SUPPLEMENT 16010 – A
SCHEDULE OF EQUIPMENT REQUIRING
OPERATION AND MAINTENANCE DATA

Item No.	Section	Manual (M) Data Sheet (D)	Description
1	13420-A	M	All instruments listed on the Instrument List in Appendix A.
2	13430	D	All junction boxes with terminal blocks.
3	13430	D	All instrument boxes with heater & viewing window.
4	13450	M	Coordinate with OWNER's System Integrator, SBR System Supplier, and DAF System Supplier for control panel O&Ms.
5	16075	D	Nameplates & Labeling Suppliers
6	16121	D	VFD Cable
7	16128	D	Heat Trace
8	16131	D	PVC-GRC conduit
9	16135	D	All junction boxes, vaults, in-ground boxes supplied.
10	16140	D	Receptacles, toggle switches, motor rated switches, thermostats.
11	16210	D	PP&L Utility Transformer Vaults & Lids
12	16232	M	Diesel Generators & Tanks
13	16410	D	Fused & Non-Fused Disconnects, Meltric Cord & Plug Assemblies
14	16416	M	Automatic Transfer Switch
15	16440	D	All panelboards
16	16447	M	Coordinate with OWNER's System Integrator and SBR System Supplier for O&Ms.
17	16460	D	All transformers
18	16511	D	Interior Luminaires
19	16512	D	Exterior Luminaires
20	16746	M	Multimode Fiber Optic Cable

END OF SUPPLEMENT

Project Name:	Project Number:
Equipment:	Equipment ID / Tag Number:
Manufacturer:	Nameplate Data:
Manufacturer's Local Supplier Name:	
Phone:	
Address:	

[illegible]

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SECTION 16015
DEMONSTRATION AND TRAINING

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) Definitions.
 - 2) General Requirements.
 - 3) Supplements.

1.2 DEFINITIONS

- a. Training Requirements.
 - 1) The following topics shall be covered at a minimum:
 - a) Equipment schematics.
 - b) Control strategy.
 - c) Troubleshooting procedures.
 - d) Recommended maintenance and periodic testing procedures.
 - e) Advanced start-up procedures.
 - f) Control Input/Output (I/O) and communications review.
 - g) Operator Interface Terminals (OIT) operating characteristics and navigation between various screens and functions.
 - h) Proper use and function of selector switches, reset buttons, speed controls, E-stops, etc.
 - 2) Training shall require one session for each type of process equipment.
- b. Manufacturer's Representative / Factory Trained Technician.
 - 1) Shall be an authorized service division employee of the manufacturer.

1.3 GENERAL REQUIREMENTS

- a. Provide training for OWNER's personnel for items listed in Supplement 16015 – A, "Schedule of Equipment Requiring Demonstration And Training".
- b. Utilize Manufacturer's Representative to conduct training sessions.
- c. CONTRACTOR shall have an employee familiar with the details of the installation attend the training sessions.
- d. The Manufacturer's Representative and CONTRACTOR shall provided the demonstration and training required to meet the performance specified herein. No costs in addition to the original Bid shall be incurred by the OWNER to meet this requirement.

- e. Schedule and coordinate training sessions to accommodate the following:
- 1) Provide fourteen (14) day written notice to the ENGINEER for approval prior to proposed training sessions.
 - 2) Do not schedule training sessions for Monday, Friday, Saturday, Sunday or a Holiday.
 - 3) No more than two (2) different types of equipment training sessions shall be scheduled for any one (1) day.
 - 4) The Manufacturer's Representative shall utilize the operation and maintenance manuals as a basis for instruction. Should the need for additional data become apparent during instruction, CONTRACTOR shall prepare and insert the additional data into the operation and maintenance manual within seven (7) business days.
 - 5) OWNER reserves the right to video tape the training session. The OWNER agrees that the video tape shall only be used for training employees.
 - 6) Provide the material, data, and training aids including, but not limited to, the copying of any documents, screens, viewers, etc. required for training session.
 - 7) Provide an outline of the topics for discussion during the training session and copies of the operation and maintenance manuals for all training session participants.
 - 8) OWNER will provide the CONTRACTOR with the number of participants at each training session seven (7) days after receipt of the proposed training session schedule.
- f. ENGINEER shall not authorize the commencement of the demonstration and training sessions until after successful demonstration of the Functional Test Certification, approval of the test reports submitted from Section 16080 – Electrical Testing and the successful demonstration of the Process Test Certification in Section 16005 – Starting And Adjusting.
- g. Should the CONTRACTOR fail to meet the scheduled training session date, OWNER shall be entitled to notification of a new date complying with the requirements indicated herein.
- h. Training sessions shall be scheduled to allow for appropriate progression of the training material. If knowledge of certain equipment is necessary to adequately comprehend the operational and maintenance aspects of another piece of equipment, the training session shall be scheduled to provide for this requirement.
- i. Training sessions shall meet the following general requirements:
- 1) Training sessions shall be completed before commissioning.

- 2) CONTRACTOR shall provide the labor, process medium, chemical, tools, equipment and instruments necessary to accommodate demonstration of the equipment. CONTRACTOR may not rely on adequate water, wastewater, storm water or other normal process flows, etc. as they may not be available.
- 3) The content of the training sessions shall be specific to the products installed.
- 4) The training sessions shall be developed to allow for appropriate presentation of information and hands-on operation and maintenance opportunities for the OWNER's staff.

PART 2: PRODUCTS – NOT USED

PART 3: EXECUTION

3.1 SUPPLEMENTS

- a. Supplement 16015 - A, "Schedule of Equipment Requiring Demonstration And Training".

END OF SECTION

SUPPLEMENT 16015 – A
SCHEDULE OF EQUIPMENT REQUIRING
DEMONSTRATION AND TRAINING

Item No.	Section No.	Description
1	Division 11	Electrical, Instrumentation & Control Components. CONTRACTOR shall provide demonstration and training in accordance with Division 11 requirements.
2	13420-A	All instruments listed in the Instrument List (Appendix A)
3	13430 & 13450	Coordinate with OWNER's System Integrator for Demonstration & Training
4	16232	Packaged Diesel Generator & Belly Tank Level Sensor
5	16410	Fused & Non-Fused Disconnects
6	16410	Enclosed Circuit Breakers
7	16410	Meltric Disconnects (Cord & Plug Assembly)
8	16416	Automatic Transfer Switches
9	16447	MCC-2000 & MCC-3000. Coordinate with the OWNER's System Integrator and the SBR System Supplier.
10	16460	Transformers
11	16511	Interior Luminaires
12	16512	Exterior Luminaires, including poles (swivel pole operation)
		OTHER ITEMS AS MAY BE SPECIFIED IN INDIVIDUAL SECTIONS.

END OF SUPPLEMENT

SECTION 16025 TEMPORARY POWER

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) Requirements for providing temporary power to critical process equipment during construction.

1.2 GENERAL REQUIREMENTS

- a. The generator supplier shall provide a factory-certified technician to provide emergency on-site troubleshooting and support. The technician shall be available on a 24/7 on-call basis. The technician shall be capable of providing on-site support within one (1) hours notice. The technician's name and cell phone number shall be provided to the OWNER. The technician's supervisor's name and cell phone number shall be provided to the OWNER.
- b. The CONTRACTOR shall be available to provide emergency on-site troubleshooting and support. The CONTRACTOR shall be available on a 24/7 on-call basis. The CONTRACTOR shall be capable of providing on-site support within one (1) hour notice.
- c. All temporary power installations shall comply with the latest edition of the National Electrical Code (NEC).
- d. Refer to Civil Drawings (Sheet G006) for suggested shutdown sequence of operations for additional information.

1.3 LARGE PORTABLE GENERATOR REQUIREMENTS

- a. The CONTRACTOR shall provide portable generators and fuel to supply temporary power to Building #9 and Building #10 as shown on the Drawings.
- b. The CONTRACTOR shall be responsible for all portable generators, cables, standard maintenance, and fuel to supply power to critical process equipment indicated within this Section. The bid form will have an allowance for fees assessed by the generator supplier.
- c. A spare portable generator shall be provided where indicated in Part 1.7 of this Section. The spare portable generator shall be stored on the jobsite for the duration of the shutdown. The CONTRACTOR shall be responsible for the spare portable generator. The bid form will have an allowance for fees assessed by the generator supplier.
- d. The CONTRACTOR shall coordinate the location in which to park portable generators during operation. The location shall be approved by the OWNER.
- e. The CONTRACTOR shall schedule the delivery of the portable generators and fuel with generator supplier.

- f. Sufficient fuel shall be provided to operate the portable generators on a continuous basis for the entire length of the shutdown.
- 1) The fuel level in the generator shall be monitored continuously. The fuel level shall not fall below 30% of full tank at any time during the shutdown.
 - 2) At no time shall it be acceptable for the generators to be inoperable due to insufficient fuel.
 - 3) The CONTRACTOR shall schedule all fuel deliveries with the generator supplier to ensure continuous operation of the generator.
 - 4) The generator supplier shall be capable of supplying fuel to the jobsite within one (1) hour of emergency notification.
- g. The CONTRACTOR shall determine the required length and quantity of power cables, and shall be responsible for all cables necessary to power the loads indicated within this Specification. The bid form will have an allowance for fees assessed by the generator supplier.
- h. The CONTRACTOR shall provide all overcurrent protection devices, branch panel boards, temporary feeders, temporary branch circuits, grounding, and a temporary stand as required to power all the equipment.
- i. The CONTRACTOR shall provide all temporary power connections between the generators and the OWNER'S power distribution equipment.
- j. The CONTRACTOR shall maintain and operate the portable generators throughout construction.
- k. Upon completion of the shutdown, the CONTRACTOR shall disconnect all temporary power connections. The CONTRACTOR shall schedule the removal of the generators and fuel with the generator supplier.

1.4 CRITICAL EQUIPMENT REQUIRING TEMPORARY POWER

- a. The following is a list of equipment that shall require large portable generators to supply temporary power:

EQUIPMENT	LOCATION	PORTABLE GENERATOR RATING	SPARE PORTABLE GENERATOR	NOTES
Building No. 9 Power Distribution	Building 9	480V, 3-phase 80 kW	480V, 3-phase 80 kW	

1.5 EQUIPMENT REQUIRING TEMPORARY POWER

- a. The following equipment shall be powered by the generator:
 - 1) Existing Irrigation Pump No. 3 – 25 hp
 - 2) Existing Sludge Pipe Flushing Pump – 10 hp
 - 3) Building #9 Transformer and Lighting Panel – 480-240/120V, 1-phase, 15kVA
 - a) Building #9 Lighting Panel – 120/240V, 1-phase, 80-amp panelboard
 - b) Building #10 Lighting Panel – 120/240V, 1-phase, 30-amp branch panelboard which is subfed from the Building #9 Lighting Panel.

1.6 SEQUENCE OF OPERATIONS

- a. Refer to Civil Drawings (G006) for suggested shutdown sequence of operations for additional information.

PART 2: PRODUCTS

2.1 PORTABLE GENERATORS AND FUEL

- a. The portable generators, cables, and fuel shall be provided by Cummins Northwest LLC, or approved equal.
- b. The Cummins Northwest LLC representative contact info:
 - 1) Nick Johnson, 503-289-0900 ext. 1403.

PART 3: EXECUTION

3.1 CONSTRUCTION

- a. The CONTRACTOR shall inform the OWNER and ENGINEER immediately if there will be a deviation in time or date from the approved shut down schedule.

END OF SECTION

SECTION 16050
COMMON WORK RESULTS FOR ELECTRICAL

PART 1: GENERAL

1.1 PERMITS, FEES AND SERVICE CHARGES

- a. The CONTRACTOR shall obtain all electrical permits required to complete the work and pay all associated fees.
- b. The CONTRACTOR shall coordinate and provide for the installation and operation of franchise utility service (including any telephone and/or leased lines specified) as required during construction, startup, testing, and operation of the work until substantial completion.

1.2 OWNER FURNISHED EQUIPMENT AND COORDINATION

- a. Definitions
 - 1) Owner: The Owner and Owner's Representative (same party for this Project).
 - 2) OSI: The Owner's System Integrator
 - 3) OFCI: Owner-Furnished, Contractor-Installed equipment and materials.
 - 4) CFCI: Contractor-Furnished, Contractor-Installed equipment and materials.
 - 5) Responsibility Matrix: The project-specific listing identifying which party furnishes and which party installs each item.
 - a) The Responsibility Matrix provided in Part 1.2, h of this Section identifies furnish/install responsibilities for major electrical equipment and I&C systems.
 - b) Where the Matrix conflicts with other Contract Documents, the more stringent requirement shall apply, and the Contractor shall promptly notify the Engineer.
 - c) "Furnished" includes procurement, associated standard accessories shipped with the item, software/licenses that are standard with the item, and manufacturer documentation shipped with the item.
 - d) "Installed" includes unloading, handling, storage, mounting, anchorage, conduit/cable/termination, grounding/bonding, labeling, field testing, start-up support, and delivering the system ready for commissioning unless otherwise stated.
- b. Scope
 - 1) OWNER will furnish the OFCI equipment identified in the Responsibility Matrix.
 - 2) CONTRACTOR shall provide all labor, supervision, tools, equipment, and incidental materials required to receive, store, protect, install, connect, test, and place OFCI equipment into service.

c. Coordination Requirements

- 1) CONTRACTOR shall coordinate with OWNER regarding delivery dates, delivery location, receiving hours, offloading requirements, storage constraints, and site access.
- 2) CONTRACTOR shall coordinate integration and start-up procedures with OWNER and the OSI as applicable for each OFCI item.
- 3) CONTRACTOR shall include in the Project Schedule all activities required for OFCI receiving, installation, integration, and commissioning.

d. Delivery, Receiving, and Storage

- 1) OWNER will coordinate shipment of OFCI equipment to the site or other designated location.
- 2) The equipment for the membrane system has already been delivered. CONTRACTOR shall be responsible for transporting this equipment from the storage site to the WTP site.
- 3) CONTRACTOR shall be responsible for:
 - a) Receiving inspection upon delivery (quantity, visible damage, completeness).
 - b) Documenting shortages or damage with photos and written notice within 48 hours of receipt.
 - c) Providing secure, weather-protected storage and environmental conditions as recommended by the manufacturer.
 - d) Maintaining custody, protection, and preservation of OFCI equipment once delivered and accepted at the site.

e. Deficiencies and Damage

- 1) Damage occurring prior to delivery to the site shall be addressed by OWNER.
- 2) Damage occurring after CONTRACTOR's acceptance at the site (including storage, handling, or installation) shall be repaired/replaced by CONTRACTOR at no additional cost to the OWNER.

f. Warranties

- 1) Manufacturer warranties for OFCI equipment shall remain in effect; CONTRACTOR shall not perform actions that void warranties.
- 2) CONTRACTOR shall provide workmanship warranty for installation and connections of OFCI equipment.

g. OWNER's SYSTEM INTEGRATOR (SI) Equipment.

- 1) The OSI will furnish the equipment and/or services identified in the Responsibility Matrix.

- 2) CONTRACTOR shall provide all labor and incidental materials to receive, store, protect, install, connect, and make operational all OSI-furnished items.
- 3) Coordination with OSI
 - a) CONTRACTOR shall coordinate directly with the OSI for integration requirements including:
 - (1) Network/communications requirements (media type, protocols, addressing, segmentation).
 - (2) Panel interface requirements (I/O lists, terminal plans, interposing relays as required).
 - (3) Power requirements (voltage, control power, UPS requirements if applicable).
 - (4) Grounding and bonding requirements for instrumentation and control equipment.
 - b) CONTRACTOR shall provide the OSI reasonable access to equipment and installed systems for configuration, checkout, and commissioning activities.
- 4) OSI-Furnished Equipment Delivery and Storage
 - a) OSI-furnished items shall be delivered in accordance with the Project Schedule and coordinated through the Contractor.
 - b) CONTRACTOR receiving/storage responsibilities for OSI-furnished equipment shall be the same as OFCI requirements.

h. OWNER FURNISHED EQUIPMENT RESPONSIBILITY MATRIXES:

1) Blower Building (SBR System) Responsibility Matrix

EQUIPMENT	CONTRACTOR		OWNER		OWNER'S SYSTEM INTEGRATOR	
	FURNISHED	INSTALLED	FURNISHED	INSTALLED	FURNISHED	INSTALLED
MCC-2000 (SSS Furnished) ⁽¹⁾		X	X			
CP-2000 (SBR Main PLC)		X			X	
CP-1000 (Headworks Control Panel)	X	X				
CP-2100 (SSS Furnished) ⁽¹⁾		X	X			
CP-2200 SBR #1 LCS (SSS Furnished) ⁽¹⁾		X	X			
CP-2400 SBR #2 LCS (SSS Furnished) ⁽¹⁾		X	X			

EQUIPMENT	CONTRACTOR		OWNER		OWNER'S SYSTEM INTEGRATOR	
	FURNISHED	INSTALLED	FURNISHED	INSTALLED	FURNISHED	INSTALLED
SBR Local Disconnects & Meltric Plugs	X	X				
SBR Junction Boxes	X	X				
PCP-2800 (Plant PS PLC)		X			X	
PDP-2800 & Meltric Disconnects		X			X	
PDP-2800 Metal Cage	X	X				
Generator Set	X	X				
Instruments ^(2,3)	X	X	X⁽³⁾		X⁽⁴⁾	
NOTES: (1) SSS = SBR System Supplier (2) Refer to Section 13420 for requirements on instrumentation and delineation of Contractor, Owner, and Owner's SI responsibilities. (3) The only instruments supplied directly by the OWNER (vs. the OSI) are the instruments included in the Owner purchased equipment packages for the SBR System and DAF Clarifier System Equipment.						

2) DAF Clarifier Building Responsibility Matrix

EQUIPMENT	CONTRACTOR		OWNER		OWNER'S SYSTEM INTEGRATOR	
	FURNISHED	INSTALLED	FURNISHED	INSTALLED	FURNISHED	INSTALLED
MCC-3000		X			X	
CP-3000 (DAF Main PLC)		X			X	
CP-3200 (DAF Motor Control) ⁽¹⁾		X	X			
CP-3205 (DAF System PLC) ⁽¹⁾		X	X			

EQUIPMENT	CONTRACTOR		OWNER		OWNER'S SYSTEM INTEGRATOR	
	FURNISHED	INSTALLED	FURNISHED	INSTALLED	FURNISHED	INSTALLED
LCP-3300 (CL2 Generator)	X	X				
LCP-3510 (SO2 Generator)	X	X				
Generator Set	X	X				
Instruments ^(2,3)	X	X	X⁽²⁾		X⁽³⁾	
NOTES: (1) DSS = DAF Clarifier System Supplier (2) Refer to Section 13420 for requirements on instrumentation and delineation of Contractor, Owner, and Owner's SI responsibilities. (3) The only instruments supplied directly by the OWNER (vs. the OSI) are the instruments included in the Owner purchased equipment packages for the SBR System and DAF Clarifier System Equipment.						

1.3 INTENT OF DRAWINGS AND SPECIFICATIONS

- a. The contract document drawings and specifications are complimentary. What is called for by one shall be binding as if called for by all. Where a conflict occurs between the drawings and specifications, the stricter of the two shall take precedence.
- b. It is the CONTRACTOR'S responsibility to schedule and coordinate the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR'S Work.
- c. 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 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 electrical 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 specification sections; 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.

- d. Riser and other diagrams are schematic and are intended to show the approximate location of equipment, and the general alignment of conduits and piping, and shall not be used for obtaining quantities. Dimensions given on the plans shall take precedence over scaled dimensions and all dimensions whether in figures or scaled, shall be verified in the field.
- e. The electrical drawings do not show complete details of the site conditions. The CONTRACTOR shall check actual conditions.
- f. The exact location of apparatus, fixtures, equipment, conduit and piping shall be ascertained by the CONTRACTOR in the field, and the work shall be laid out accordingly. Should the CONTRACTOR fail to ascertain such locations or coordinate with work performed by other trades, the work shall be changed at no additional cost to the OWNER when so ordered by the ENGINEER. The ENGINEER reserves the right to make minor changes in the location of conduit, piping and equipment up to the time of installation without additional cost to OWNER.
- g. CONTRACTOR shall provide all labor, materials, equipment, machinery, and tools necessary to provide all electrical equipment specified and shown on the Drawings. All items not specified in detail or shown on the Drawings but necessary for complete installation shall be provided by the CONTRACTOR.
- h. All electrical equipment and systems for the entire project shall comply with the requirements of the Electrical Specifications, whether referenced in the equipment specifications and drawings, or not.
- i. The Contractor shall inform all subcontractors and vendors of the requirements of the Electrical Specifications.
- j. The Owner is not responsible for any additional costs due to the failure of the Contractor to notify all subcontractors and suppliers of the Electrical Specifications requirements.
- k. Schematic diagrams:
 - 1) All controls are shown de-energized.
 - 2) Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.
 - 3) 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.
 - 4) Mount all devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated.
 - 5) Schematic diagrams are to be used in conjunction with the descriptive operating sequences in the Contract Documents. Combine all information and furnish a coordinated and fully functional control system.

1.4 CONTRACTOR'S RESPONSIBILITY FOR FIELD VERIFICATION OF EXISTING CONDITIONS

- a. The CONTRACTOR shall be responsible for performing field verification of the existing conditions prior to bidding. The nature of this work inherently requires field observation to understand the existing conditions and scope of work.
- b. Failure to observe the existing conditions or ignorance of existing conditions shall be the responsibility of the CONTRACTOR alone. Additional services shall not be authorized due to the CONTRACTOR'S lack of understanding of the existing conditions.

1.5 CONTRACTOR'S RESPONSIBILITY FOR SHUTDOWNS AND MAINTAINING EXISTING SYSTEMS

- a. Shutdowns of any Division 13 or 16 system shall be coordinated with the OWNER prior to performing the shutdown. The CONTRACTOR shall provide the OWNER with a written schedule identifying the system, duration, and impact on the OWNER's facility.
- b. Existing Division 13 or 16 systems not impacted by the work in this project shall be protected and maintained during construction. Any system not identified on the Drawings or within these Specifications shall be brought immediately to the attention of the ENGINEER and OWNER.
- c. The CONTRACTOR shall be responsible for bearing the cost of repairing or restoring all electrical systems that are disrupted or damaged during construction. The systems shall be repaired and restored to their original condition.

1.6 SUBSTITUTION REQUESTS FOR MECHANICAL, HVAC, PROCESS, OR OTHER EQUIPMENT IMPACTING THE ELECTRICAL DESIGN

- a. The CONTRACTOR shall be responsible for including the cost impact to the electrical systems for substitution requests and/or value engineering for mechanical, HVAC, process, or other equipment made by other trades. The costs to the overall substitution request or value engineering solution must be included in the total number provided to the OWNER. The CONTRACTOR is responsible for coordinating the substitution requests or value engineering proposals made by other trades.
- b. Any substitution request and/or value engineering solution which impacts the electrical design but does not include the costs shall be unacceptable.
- c. Failure of other subcontractors to include the electrical cost impact shall not be the basis for a change order. The CONTRACTOR shall be responsible for coordinating the total costs of all substitution requests and/or value engineering solutions prior to presenting them to the ENGINEER or OWNER. When these requests are received by the ENGINEER or OWNER to review and approve, the ENGINEER and OWNER shall assume the cost impact to electrical has been included.

1.7 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.

b. Submittal Format:

- 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
- 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
- 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
- 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

c. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the following:

- 1) Submittals shall include information and literature as required for all equipment and materials provided under this and related sections.
- 2) Shop Drawings: Shop drawings shall include the following along with any special requirements listed in the individual Specification Sections:
 - a) Installation instructions and drawings
 - b) Wiring schematics with termination point identification
 - c) Motor information
 - d) Materials of construction
 - e) Manufacturer's name and model
 - f) Manufacturer's catalog data
 - g) Supplementary structural framing for electrical equipment including design loads, member size and location. When supplementary framing is indicated, verify that dimensions are suitable for the equipment furnished. Provide additional strength when equipment furnished is heavier than that specified.
- 3) Manufacturers' Literature: Literature indicating the compliance of the products with the Specifications shall be included with all submittals. This shall include catalogs and other descriptive bulletins. Relevant portions of the literature shall be clearly identified by highlighting or underlining.

- 4) Test Logs: The CONTRACTOR shall submit test logs as outlined below and as specified in subsequent electrical sections and drawings.
 - a) A log of the complete results of tests for shorts and grounds for each circuit. All circuits and tests shall be clearly identified.
 - b) A log of complete results of insulation resistance measurements of each circuit. All circuits and tests shall be clearly identified.
- 5) Operation and maintenance information for all equipment furnished and/or installed.
- 6) Programming instructions for any controllers or other programmable equipment. Copies of the any required software, including registration cards, shall be provided with the O&M manuals.
- d. The CONTRACTOR shall indicate on the submittals all variances from the Specifications.
- e. Record Drawings. After the completion of construction, the CONTRACTOR shall provide one set of “as-built” drawings to the ENGINEER as specified herein showing the location of buried conduits and all changes or deviations from the original drawings.
- f. After the completion of construction, a printout and electronic copy of any programming and/or set-points for controllers, PLCs, meters or other programmable equipment, including VFDs.
- g. Final inspection certificates shall be submitted prior to final payment.

1.8 INTERFACES WITH EQUIPMENT INSTRUMENTS, AND OTHER COMPONENTS:

- a. 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.
- b. Provide all material and labor needed to install the actual equipment furnished, and include all costs to add any additional conduit, wiring, terminals, or other electrical hardware to the Work, which may be necessary to make a complete, functional installation based on the actual equipment furnished:
 - 1) Make all changes necessary to meet the manufacturer’s wiring requirements.
- c. All electrical equipment and systems for the entire Project must comply with the requirements of the Electrical Specifications, whether referenced in the individual Equipment Specifications or not:
 - 1) The requirements of the Electrical Specifications apply to all Electrical Work specified in other sections, including HVAC controls, packaged mechanical systems, LCPs, VCPs, etc.

- 2) Inform all vendors supplying electrical equipment or systems of the requirements of the Electrical 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 Electrical Specifications requirements.
- d. Special subcontractor requirements:
- 1) As specified elsewhere in this Section, provide the Work specified in the Electrical Specifications by a qualified electrical subcontractor.

1.9 COORDINATION OF WORK

- a. The CONTRACTOR shall plan their work in coordination with the other trades and with the power and telephone utility authorities.
- b. The CONTRACTOR shall field verify all dimensions of equipment to be installed or provided by others so that correct clearances and connections may be made between the work installed by the CONTRACTOR and equipment installed or provided by others.
- c. The CONTRACTOR shall arrange all conduit runs so that they do not interfere with piping, structural members, etc.
- d. All working measurements shall be taken from the sites, checked with those shown on the drawings, and if they conflict, reported to the ENGINEER at once, and before proceeding with the work. Should the CONTRACTOR fail to comply with this procedure, he shall alter his work at his own expense as directed by the ENGINEER.
- e. No additional payments will be allowed where obstructions in the work of other trades, or work under this contract requires offsets to conduit runs.
- f. The CONTRACTOR is responsible for all alterations in the work to accommodate equipment differing in dimensions or other characteristics from that shown or specified.
- g. The CONTRACTOR shall provide all temporary power necessary for existing site equipment and for all construction needs.

1.10 SUPERVISION

- a. The CONTRACTOR shall maintain adequate supervision of the work and shall have a responsible person in charge at the site during all times that work under this contract is in progress, or when necessary for coordination with other work.

1.11 CODES

- a. Work shall conform to the National Electrical Code (NEC), and State Codes and other applicable codes, even though not specifically mentioned for each item. These shall be regarded as the minimum standard of quality for materials and workmanship.

1.12 QUALITY ASSURANCE

- a. System supplier responsibilities:
 - 1) Requirements as specified in the Instrumentation and Control Specifications.
 - 2) System supplier:
 - a) Due to the critical and complex technical requirements of this Project, all Work (materials, equipment, products, submittals, labor, services, etc.) specified in the Electrical, and Instrumentation and Control Specifications, and shown on the Electrical and Instrumentation Drawings is to be furnished by a single system supplier who has single source responsibility for both the process control and instrumentation systems and the electrical power system.
 - 3) Contractual relationship:
 - a) Form a contractual relationship between the electrical subcontractor and the Instrumentation and Control Subcontractor (ICSC).
 - b) Requirements for the first-tier subcontractor:
 - 1. Contract directly with the Contractor.
 - 2. Be either the electrical subcontractor or the ICSC.
 - c) Requirements for the second-tier subcontractor:
 - 3. A division of the first-tier subcontractor, or
 - 4. A joint venture with the first-tier subcontractor, or
 - 5. A subcontractor to the first-tier subcontractor.
 - d) The system supplier manages, directs, and supervises all the Work of its second-tier subcontractor. The system supplier is solely responsible for the entire electrical and instrumentation system, including, but not limited to, all Electrical, Instrumentation, and Process Contract Drawings, Electrical Specifications, and Instrumentation and Control Specifications:
 - 6. Provide any additional conduit, wire, etc.
 - 7. Any additional I/O, programming, screens, interface devices needed by the system supplier are to be provided by the electrical subcontractor or the ICSC, under the above outlined working agreement.
 - 8. Ensure compatibility between the Process Control and Instrumentation System (PCIS) and the electrical system being installed.

1.13 SITE OR PROJECT CONDITIONS

- a. Provide enclosures for electrical, instrumentation and control equipment, regardless of supplier or subcontractor furnishing the equipment, that meet the requirements outlined in NEMA Standard 250 for the following types of enclosures:
 - 1) NEMA Type 1: Intended for indoor use, primarily to provide a degree of protection from accidental contact with energized parts or equipment.

- 2) NEMA Type 4: Intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing or hose directed water, ice formation and freezing.
- 3) NEMA Type 4X: Made from corrosion resistant materials (316 stainless steel) and are intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing or hose directed water, ice formation and freezing, and corrosion.
- 4) NEMA Type 12: Intended for indoor use, primarily to provide a degree of protection from dust, falling dirt and dripping non-corrosive liquids.
- 5) NEMA Type 6: Rated for submergence.
- 6) NEMA Type 6P: Rated for prolonged submergence.
- 7) NEMA Type 7: Intended for installation in locations where explosive or combustible gas or vapors may be present (Class I Division 1 or Class I Division 2) meeting the requirements outlined in Section 16052.
- 8) NEMA Type 8: Intended for installation in either indoor or outdoor locations where explosive or combustible gas or vapors may be present (Class I Division 1 or Class I Division 2) and the equipment is oil-immersed, meeting the requirements outlined in Section 16052.

b. Plant Area Electrical Work Requirements:

- 1) Provide all Electrical Work in accordance with the following table, unless otherwise specifically indicated on the Drawings.
- 2) Provide stainless steel NEMA 4X enclosures and supports, and PVC-GRC conduit type for all Electrical work not included in the following table unless otherwise indicated on the Drawings. Conduit type definitions are listed under 16130 – Conduit and Fittings, 1.03B.
- 3) Reference Section 16070 – Hangers and Supports and 16130 – Conduit and Fittings for detailed requirements.

PLANT AREA	NEMA ENCLOSURE TYPE	EXPOSED CONDUIT TYPE	ENVIRONMENT W = WET D = DAMP C = CLEAN/DRY X = CORROSIVE H = HAZARDOUS	SUPPORT MATERIALS & HARDWARE	ANCHOR MATERIALS
Exterior	NEMA 3R	GRC	W, D	SST	SST
Interior	NEMA 12	EMT	C	Hot Dipped Galvanized	Hot Dipped Galvanized
Underground	N/A	PVC 40	W, D	N/A	N/A
Hazardous Locations (C1D1 – Wet Well, SBR, etc.) (1)	NEMA 7, EXP	PVC-GRC	H	SST	SST

PLANT AREA	NEMA ENCLOSURE TYPE	EXPOSED CONDUIT TYPE	ENVIRONMENT W = WET D = DAMP C = CLEAN/DRY X = CORROSIVE H = HAZARDOUS	SUPPORT MATERIALS & HARDWARE	ANCHOR MATERIALS
Hazardous Locations (C1D2 – Plant PS, SBR, etc.) ⁽¹⁾	NEMA 4X	PVC-GRC	H	SST	SST
SBR Basins (Non-Hazardous Areas)	NEMA 4X	PVC-GRC	X	SST	SST
Chemical Processing (SO ₂ , CL ₂ , etc.) ⁽²⁾	NEMA 4X	PVC80	X	SST	SST
NOTES: (1) Reference drawings for Hazardous Location Area Classifications. Install in accordance with Section 16052. (2) Install corrosion resistant boxes, conduit, and supports within 5-ft of the chemical processing equipment.					

1.14 WIRING WITHIN CONDUIT

- a. All wiring shall be installed within a conduit, raceway, or tray as identified within Contract Documents, no exceptions.
 - 1) All wiring associated with low voltage systems, including, but not limited to low voltage communications, electronic access control, building automation / HVAC control, security systems, and fire alarm systems shall be in conduit, no exceptions.
 - 2) All Class II wiring shall be within conduit, no exceptions.

1.15 CONTRACTOR'S RECORD DRAWINGS & AS-BUILTS

- a. The CONTRACTOR shall maintain a neatly marked set of record drawings showing the locations of all buried conduits and other utilities encountered or installed during construction. The final locations of panels, field mounted instruments and panels, terminal boxes, junction boxes, receptacles, light switches and other materials included in the work shall be shown, as well as conduit routing between them to the extent it differs from the design drawings. Record drawings shall be kept current with the work as it progresses and shall be subject to inspection by the OWNER's Representative at any time. Failure to keep field record drawings current may result in the issuance of a stop work order or delay in the processing of pay requests until the record drawings are made current.
- b. The CONTRACTOR shall provide one complete set of as-built electrical schematics for all panels and equipment provided, including PLC I/O schematics as applicable, panel elementary diagrams, interconnecting wiring diagrams, wire numbers, termination strip locations and numbers. These shall be in the same format and style as those in the Contract Documents and submittal requirements.

- c. All information shown on the CONTRACTOR's field record drawings and as-built schematics shall be subject to verification by the OWNER's Representative. If significant errors or deviations are noted by the OWNER's Representative, new as-builts shall be completed at the CONTRACTOR's expense.

PART 2: PRODUCTS

2.1 PORTABLE OR DETACHABLE PARTS

- a. The CONTRACTOR shall retain in his possession and shall be responsible for all portable and detachable parts or portions of installations such as fuses, key locks, adapters, blocking chips and inserts until completion of his work.
- b. These parts shall be delivered to the ENGINEER and an itemized receipt obtained. This receipt, together with 2 copies of the final inspection certificate, shall be attached to the CONTRACTOR's request for final payment.
- c. All equipment shall be demonstrated to operate in accordance with the requirements of this specification and the manufacturer's recommendations.

2.2 NEW PRODUCTS

- a. All products shall be new without defects and covered by Manufacturer's warranty. Products shall be re-used only where indicated on the Drawings.
- b. All products shall be listed, labeled, and certified by a testing agency approved by the state of Oregon.
- c. All equipment of the same type and capacity shall be by the same manufacturer.

2.3 Floor mounted equipment

- a. Floor mounted electrical equipment shall be installed on a concrete equipment pad. The equipment pad shall be 4" high with a minimum 2" reveal on each side of the equipment. The electrical equipment shall be arranged so that the uppermost operating handle shall not exceed 6 feet 6 inches from the floor.

PART 3: EXECUTION

3.1 IDENTIFICATION

- a. All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.

3.2 WORKMANSHIP & COORDINATION

- a. All work shall be performed by personnel skilled in the particular trade in a workmanlike manner. Workmanship shall conform to the standards of the NEC and the National Electrical Installation Standards (NEIS).

- b. The ENGINEER shall be the sole judge as to whether or not the finished work is satisfactory; and if in his judgment any material or equipment has not been properly installed or finished, the CONTRACTOR shall replace the material or equipment whenever required, and reinstall it in a manner entirely satisfactory to the ENGINEER without any increase in cost to the OWNER.
- c. The CONTRACTOR shall coordinate and verify the installation of all equipment furnished by him to other trades, or equipment provided and installed by other trades that is connected to the electrical or control systems. Work shall include the furnishing of all labor, materials, and equipment required for the installation of a complete and operable system as hereinafter specified and as indicated on the drawings. The Contract Documents are complementary and what is called for by any one shall be as binding as if called for by all. Unless otherwise specifically stipulated, the term "furnished and installed complete" shall be considered a part of this section.
- d. Controls and systems shall be complete with transformers, switches, relays, contactors, control valves, control devices, instrument piping, fittings, valves, control wiring, thermometers, pressure gauges, thermostats, damper operators, miscellaneous control cabinets to fill the intent of the Specifications and shall provide control for the various units and systems. All control valves and motorized dampers shall be provided with position indicators.
- e. Unless otherwise specified or shown on the drawings, switches or relays shall be installed in, or adjacent to the motor starter or other electrical device to which they are to be connected. Control and interlock wiring shall be included as necessary from breakers specified herein or shown on the drawings.
- f. Each control schematic intended to control a series of motor operated louvers, fans, and thermostats shall contain a switch for maintenance to meet the NEC requirements regarding disconnect switches for motors. This switch shall be local if any unit controlled is out of sight of the switch. This switch shall disconnect all power to all motor operated devices within the circuit.

3.3 INSTALLATION

- a. Equipment locations shown on Electrical Drawings may change due to variations in equipment size or minor changes made by others during construction.
 - 1) Verify all dimensions shown on the Drawings.
- b. Review all Contract Documents and approved equipment shop drawings and coordinate Work as necessary to adjust to all conditions that arise due to such changes.
- c. Make minor changes in location of equipment before rough in, as directed by the Owner or ENGINEER.
- d. Submit a Request for Information for any conflict between the Drawings and Specifications prior to installation.

- e. Install all conduits and equipment in such a manner as to avoid all obstructions and to preserve headroom and keep openings and passageways clear.
 - 1) Install all conduits and equipment in accordance with working space requirements as outlined in the NEC.
 - 2) Where the Drawings do not show dimensions for locating equipment, install equipment in the approximate locations indicated on the Drawings. Adjust equipment locations as necessary to avoid any obstructions or interferences.

3.4 TEMPORARY HEATING, LIGHTING AND POWER

- a. The CONTRACTOR shall provide all heat, lighting and power required to construct and protect the work until the work is placed in service by the OWNER for beneficial use of the OWNER. Temporary heaters shall be provided as required to keep the work area and all new electrical components dry.
- b. The source for temporary power shall be from the electric utility or OWNER approved CONTRACTOR supplied auxiliary power units. The installation for electric power shall meet the requirements of local authorities and of OSHA.
- c. The CONTRACTOR shall obtain all permits and pay all costs for connecting temporary power service at no expense to the OWNER.

3.5 SUPPORT BACKING

- a. Provide any necessary backing required to properly support all fixtures and equipment installed under this contract.

3.6 CUTTING, PATCHING AND FRAMING

- a. The CONTRACTOR shall determine in advance the locations and sizes of all sleeves, chases, and openings necessary for the proper installation of his work.
- b. Whenever practical, inserts or sleeves shall be installed prior to covering work. Cutting and patching shall be held to a minimum. All required holes in concrete construction shall be made with a core drill and patched with non-metallic non-shrink grout.
- c. Cutting, fitting repairing and finishing of carpentry work, metal work, or concrete work, and the like, which may be required for this work shall be done by craftsmen skilled in their respective trades. When cutting is required, it shall be done in such a manner as not to weaken walls, partitions, or floors; and holes required to be cut in floors must be drilled without breaking out around the holes.
 - 1) Perform all patching to the same quality and appearance as the original work. Employ the proper tradesmen to secure the desired results. Seal around all conduits, wires, and cables penetrating walls, ceilings, and floors in all locations.
- d. Secure the permission of the ENGINEER before performing any operation likely to affect the strength of a structural member such as drilling, cutting or piercing.

- 1) Before cutting, channeling, or core drilling any surface, ensure that no penetration of any other systems will be made. Verify the area is clear and free of conduits, cables, piping, ductwork, post-tensioning cables, etc.
 - 2) Use tone-locate system or X-ray to ensure the area is clear of obstructions.
- e. Review the complete Drawing set to ensure that there are no conflicts or coordination problems before cutting, channeling, or core drilling any surface.

3.7 TESTS

- a. The CONTRACTOR shall furnish all labor, material, instruments and tools to make all connections for testing of the electrical and instrumentation installation. All equipment shall be demonstrated as operating properly prior to the acceptance of the work. All protective devices shall be operative during testing of equipment. The tests shall be made under the supervision of the ENGINEER. All deficiencies or unsatisfactory conditions as determined by the ENGINEER or inspecting authorities shall be corrected by the CONTRACTOR in a satisfactory manner at his own expense.
- b. After visual inspection of joints and connections and the application of tape and other insulating materials, all sections of the entire wiring system shall be thoroughly tested for shorts and grounds. A log of results for each circuit shall be kept by the CONTRACTOR and presented to the ENGINEER.
- c. A phase rotation check shall be made to demonstrate that all power receptacles, service feeders, main power feeders and auxiliary power generators have the same A - B - C phase rotation and ground relationships.
- d. Equipment shall be tested by operating all electric motors, relays, controls, switches, heaters, etc., sufficiently to demonstrate proper installation and electrical connections. Control and emergency conditions shall be artificially simulated where necessary for complete system or subsystem.

3.8 CLEANING AND TOUCH-UP PAINT

- a. Upon completion of work, all electrical equipment shall be cleaned.
 - 1) Vacuum all dirt, metal shavings, and foreign materials from all enclosures. The use of compressed air shall not be acceptable.
 - 2) All stains, dirt, and fingerprints shall be removed from switchboards, motor control centers, panelboards, light fixtures, enclosures, and all other electrical equipment covers.
- b. Provide touch-up paint on equipment that has been scraped, scratched, or chipped during construction. Paint color shall match color of equipment.

3.9 COORDINATION OF STARTUP AND ADJUSTING, COMMISSIONING, DEMONSTRATION AND TRAINING, AND OPERATION AND MAINTENANCE DATA.

- a. Reference the following sections for detailed requirements:

- 1) Section 16001 – Commissioning
- 2) Section 16005 - Starting and Adjusting
- 3) Section 16010 - Operation and Maintenance Data
- 4) Section 16015 - Demonstration and Training

END OF SECTION

SECTION 16052
HAZARDOUS CLASSIFIED AREA CONSTRUCTION

PART 1: GENERAL

1.1 SUMMARY

- a. Section includes:
 - 1) Executing and completing Work in hazardous and/or classified areas as defined by the NEC Articles 500 through 516,
 - 2) NFPA 820, and as indicated on the Drawings and specified in the Specifications.
- 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. As specified in Section 16050, Common Work Results for Electrical.

1.3 DEFINITIONS

- a. As specified in Section 16050, Common Work Results for Electrical.
- b. Specific definitions:
 - 1) For the purposes of these Specifications, the terms "Hazardous" and "Classified" will be considered synonymous.

1.4 SYSTEM DESCRIPTION (NOT USED)

1.5 SUBMITTALS

- a. Furnish submittals as specified in Section 01300, Submittal Procedures and Section 16050, Common Work Results for Electrical.

1.6 QUALITY ASSURANCE

- a. As specified in Section 16050, Common Work Results for Electrical.
- b. Regulatory requirements:

- 1) All wiring in hazardous and/or classified locations shall comply with all applicable articles of the NEC, in particular Articles 500 through 516.
- 2) Except as modified in Articles 500 through 516, all other applicable rules contained in the NEC shall apply to electric equipment and wiring installed in hazardous and/or classified locations.
- 3) All devices used in Class I Division 1 or Division 2 areas must have visible manufacturer installed nameplates specifically stating the Class, Division, and Group for which the device is approved.

1.7 DELIVERY, STORAGE, AND HANDLING

- a. As specified in Section 16050, Common Work Results for Electrical.

1.8 PROJECT OR SITE CONDITIONS

- a. A list of hazardous areas is specified in Section 16050, Common Work Results for Electrical and indicated on the Drawings.

PART 2: PRODUCTS

2.1 COMPONENTS

- a. Conduit and sealing fittings:
 - 1) As specified in Section 16130, Common Work Results for Electrical.
- b. Conduit boxes and bodies:
 - 1) As specified in Section 16134, Boxes.
- c. Wiring devices:
 - 1) As specified in Section 16140, Wiring Devices.

PART 3: EXECUTION

3.1 INSTALLATION

- a. As specified in Section 16050, Common Work Results for Electrical.
- b. Conduit installation:
 - 1) As specified in Section 16130, Conduits.
 - 2) Wrench tighten all conduit joints to minimize sparking when fault current flows through the conduit system.

- 3) Make all conduit connections so that there is a minimum of 5 threads fully engaged in the connection.
- c. Flexible conduit:
- 1) Class I Division 1 hazardous areas:
 1. Approved and marked suitable for Class I Division 1.
 2. Listed for compatibility with the group type atmosphere where used.
 - 2) Class I Division 2 areas:
 1. Liquidtight metal conduit with approved fittings.
 2. Maximum length as specified in Section 16130, Conduits.
- d. Sealing fittings:
- 1) Provide an approved seal, no more than 18 inches from the enclosure, for all conduits entering an enclosure containing switches, circuit breakers, fuses, relays, resistors, or any other apparatus which may produce arcs, sparks, or high temperatures:
 - a) Only explosion proof unions, couplings, elbows, capped elbows, and conduit bodies like “L”, “T”, and “X” may be installed between the sealing fitting and the enclosure.
 - 2) Provide entire assemblies approved for Class I locations for self- sealing or factory sealed assemblies where the equipment that may produce arcs, sparks, or high temperatures is located in a compartment separate from the compartment containing splices or taps, and an integral seal is provided where conductors pass from one compartment to the other:
 - a) Seals are required in all conduit connections to the compartment containing splices and must be within 18 inches of the enclosure.
 - 3) Install a conduit seal within 18 inches of the boundary in each conduit run entering or leaving a classified location. No union, coupling, box, or fitting is allowed in the conduit between the sealing fitting and the point at which the conduit leaves the classified location.
 - 4) For underground conduits entering or leaving a classified location or between Class I Division 1 and Division 2 locations:
 - a) Provide a conduit seal at both points where the conduit emerges from the ground:
 - b) Place the conduit seal within 18 inches of finished grade.
 - c) No union, coupling, box, or fitting is allowed in the conduit system between the seal fitting and the point at which the conduit enters the ground.

- 5) Separate all conductors within the conduit system and seal using an approved packing dam installed to both hold the sealing compound and to maintain the separation between the wires:
 - a) Remove the outer jacket of multi-conductor non-shielded cables in the area of the sealing fitting and separate each conductor from the cable and seal individually.
 - 6) Install seals with drains in all electrical control stations, low points of conduit or any place where moisture may condense and accumulate.
 - 7) Install the sealing compound with a minimum thickness of 5/8 inch or the trade size of the conduit, whichever is greater.
 - 8) All motors, actuators, and instrument transmitters required to have conduit seals shall have a union installed between the seal and the respective motor, actuator, or instrument transmitter. This will permit the motor, actuator, or transmitter to be disconnected or replaced without disturbing the wiring or conduit seal.
- e. Boxes and fittings:
- 1) Class I Division 1 areas:
 - 2) Utilize threaded connections for all metallic boxes, fittings, and joints to the conduit system.
 - 3) Class I Division 2 areas:
 - 4) Provide approved grounding bushings on conduits entering and exiting metallic boxes to bond the conduits together.
- f. Outlet boxes and bodies:
- 1) Provide conduits bodies and boxes suitable for the conduit system as specified in Section 16130, Conduits.
 - 2) Class I Division 2 areas:
 - 3) Boxes not containing arcing parts:
 1. Material and NEMA ratings as specified in Section 16050, Common Work Results for Electrical.
 2. Pressed metal boxes are not allowed.
 - 4) Provide heavy duty cast construction type conduit fittings and joints:
 1. Explosion proof rated fittings and joints are not necessary.
 - 5) Any enclosure containing arcing parts, etc. shall have all construction associated with the enclosure, conduit system, etc. conforming to Class I Division 1 construction.

g. Motor connections:

- 1) Conduit installation in Class I Division 1 and Class I Division 2 locations for motors that contain arcing parts, shall proceed as follows:
 - a) First - Conduit.
 - b) Second - Explosion proof flexible coupling.
 - c) Third - Sealing fitting.
 - d) Fourth - Explosion proof union.
 - e) Fifth - Connection to the motor terminal box.
- 2) Wiring connections to motor leads shall be as specified in Section 16150, Low Voltage Wire Connections.
- 3) Bond the non-current-carrying metal parts of equipment, raceways and other enclosures as required by the NEC to ensure electrical continuity.

h. Grounding

- 1) A grounding conductor shall be provided in all raceways, junction boxes, and enclosures located within all Class 1 Division 1 and Class 1 Division 2 locations.

3.2 TESTING AND FACILITY STARTUP

- a. As specified in Section 01756, Testing, Training and Facility Startup.

3.3 FIELD QUALITY CONTROL

- a. As specified in Section 16050, Common Work Results for Electrical.
- b. Obtain inspection and approval from the Engineer before and after each seal is poured.

END OF SECTION

SECTION 16057
ELECTRICAL SYSTEMS ANALYSIS

PART 1: GENERAL

1.1 SUMMARY

a. Section Includes:

- 1) The section includes the requirements for a Short-Circuit Study, Protective Device Coordination Study, Arc Flash Study, and Arc Flash Warning Labels.

1.2 REFERENCES

a. Referenced Standards:

- 1) American National Standards Institute (ANSI).
- 2) Institute of Electrical and Electronics Engineers (IEEE):
242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
399, Recommended Practice for Industrial and Commercial Power System Analysis.
1584, Guide for Performing Arc Flash Hazard Calculations.
- 3) National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
- 4) National Fire Protection Association (NFPA):
70, National Electrical Code (NEC).
70E, Standard for Electrical Safety in the Workplace.
- 5) Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910, Subpart S, Electrical.

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they

are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

- 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
- 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

c. Product Data:

- 1) Pursuant to 01300 Submittal Procedures.
- 2) Arc Flash Warning Label templates.

1.4 QUALITY ASSURANCE

- a. Short circuit, protective device coordination, and arc flash studies shall be provided by a corporately and financially independent, unbiased, testing authority. The testing authority shall be independent of manufacturers, suppliers, and installers of equipment being tested. The testing authority shall have a minimum of five (5) years experience testing similar projects.

1.5 SEQUENCING AND SCHEDULING

- a. Initial complete protective device coordination and arc flash studies shall be submitted within 90 days after approval of initial short circuit study.
- b. Revised short circuit, protective device studies, arc flash studies, and arc flash labels shall be submitted 10 days before energizing electrical equipment.
- c. Final short circuit, protective device studies, and arc flash studies shall be completed prior to project completion. Final version of study shall include as-built equipment, materials, and parameter data or settings entered into equipment based on study.
- d. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to project completion.

1.6 GENERAL STUDY REQUIREMENTS

- a. The Study shall demonstrate the following:
 - 1) The study shall comply with the current edition of the Oregon Electrical Specialty Code and NFPA 70E, an Article 701 Legally Required Standby System.

- 2) Short circuit current levels and ratings of all electrical equipment.
- b. The CONTRACTOR shall be responsible for providing all information to the Agent responsible for performing the Study. At minimum, the CONTRACTOR shall provide the following:
 - 1) Service transformer nameplate information
 - 2) Service entrance feeder conductor size, type, length and feeder conduit size, type, and length.
 - 3) Service entrance equipment nameplate information.
 - 4) Motor load nameplate information.
 - 5) Distribution feeder size, type, and length.
 - 6) Overcurrent protection device nameplate information and trip settings.
 - 7) Panelboard nameplate information.
 - 8) Any other information requested by the testing Agent.
- c. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on the Drawings.
- d. Perform studies using one of the following electrical engineering software packages:
 - 1) SKM Power Tools for Windows
 - 2) ETAP
 - 3) EDSA
 - 4) Easy Power
- e. Perform complete fault calculations for all new and future loads indicated on the Drawings.
- f. Provide individual protective device time-current characteristics for the low voltage distribution system.

PART 2: STUDIES AND PRODUCTS

2.1 SHORT CIRCUIT STUDY

- a. General
 - 1) Prepare a Short Circuit Study in accordance with IEEE 39.
 - 2) Cable impedances shall be based on copper conductors.

- 3) Bus impedances shall be based on copper buses.
 - 4) Cable and bus resistances shall be calculated at 25 degrees Celsius.
 - 5) Medium voltage cable reactance shall be based on typical dimensions for standard cables with 133% insulation levels.
 - 6) 600-volt cable reactance shall be based on the typical dimensions of THWN-2 conductors.
 - 7) Transformer impedances shall be 92.5% of nominal impedance based on tolerances specified in IEEE C57.12.00.
- b. The Short Circuit Study final report shall include the following:
- 1) Basic description, purpose, and scope of the study.
 - 2) Descriptions of the scenarios evaluated and identification of the scenario used to evaluate short circuit ratings.
 - 3) Explanation of bus and branch numbering system.
 - 4) Prevailing conditions.
 - 5) Selected base per unit quantities.
 - 6) Source impedance data, including electric utility system, generator, and motor fault contribution characteristics.
 - 7) Impedance diagrams.
 - 8) Zero-sequence impedance diagrams.
 - 9) One line diagrams and associated tabulations of data used to model the system components.
 - 10) Calculation methods and assumptions.
 - 11) Typical calculations.
 - 12) Tabulation of calculation quantities.
 - 13) Results, conclusions, and recommendations.
- c. The short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault shall be calculated at each:
- 1) Utility Service point.
 - 2) Medium Voltage Switchgear.

- 3) Low Voltage Switchgear.
 - 4) Switchboard.
 - 5) Motor Control Center.
 - 6) Automatic Transfer Switch.
 - 7) Distribution Panel.
 - 8) Branch Circuit Panelboard.
 - 9) Future load contributions as shown on the One-Line Diagram.
 - 10) Any additional point within the power distribution system as specified by the Engineer.
- d. The Short Circuit Study shall be used to verify the following:
- 1) Equipment and protective devices are applied within their ratings.
 - 2) Adequacy of distribution equipment bus bars to withstand short circuit stresses.
 - 3) Cable and bus way sizes for ability to withstand short circuit heating, in addition to normal current loads.
- e. Provide a tabulation of equipment short circuit versus available fault duties. The tabulation shall identify percentage of rated short circuit current and clearly identify equipment with insufficient ratings.
- 1) General Data
 - a) Short circuit reactance of rotating machines.
 - b) Cable and conduit material data.
 - c) Bus data.
 - d) Transformer data.
 - e) Circuit resistance and reactance values.
 - 2) Short Circuit Data
 - a) Fault impedances.
 - b) X/R ratios.
 - c) Asymmetry factors.
 - d) Motor contributions.

- e) Short circuit kVA.
 - f) Symmetrical and asymmetrical fault currents.
- 3) Equipment Evaluation
 - a) Equipment bus bracing, equipment short circuit rating, transformer, cable, busway.
 - b) Maximum fault current available.
- f. Provide a written summary at the end of the Short Circuit Study, which shall include the following:
 - 1) Selected equipment deficiencies.
 - 2) Results of short circuit study.
 - 3) Conclusions and recommendations.
- g. The Contractor shall be notified in writing of existing circuit protective devices improperly rated for new fault conditions.
- h. The Short Circuit Study data shall be revised for as-built conditions.

2.2 PROTECTIVE DEVICE SETTINGS STUDY

- a. General
 - 1) The Protective Device Settings Study shall be used to determine recommended circuit breaker settings that provide a balance between equipment protection and selective device operation that is optimum for the electrical system. Provide an analysis of all possible operating scenarios which will be or have been influenced by the proposed or completed additions or changes to the system. The study shall be prepared in accordance with ANSI/IEEE 399 and ANSI/IEEE 242.
- b. The Protective Device Settings Study shall include the following:
 - 1) Basic description, purpose, and scope of the study.
 - 2) Descriptions of the scenarios evaluated and identification of the scenario used to evaluate short circuit ratings.
 - 3) Prevailing Conditions.
 - 4) One Line Diagrams.
 - 5) Explanation of bus and branch numbering system.
 - 6) Calculation methods and assumptions.

- 7) Typical calculation.
 - 8) Tabulation of calculated quantities.
 - 9) Time-current curves for overcurrent protection devices.
 - 10) Results, conclusions, and recommendations.
- c. The Protective Device Settings Study shall be used to verify the following protective device time-overcurrent settings:
- 1) Long Time Delay Pick Up.
 - 2) Long Time Delay.
 - 3) Short Time Delay Pick Up.
 - 4) Short Time Delay.
 - 5) Instantaneous Trip.
 - 6) Ground Fault Pick Up.
 - 7) Ground Fault Delay.
 - 8) Current Transformer (CT) Ratios.
 - 9) Time-Dial Multiplier.
 - 10) Tap Settings.
- d. Tabulation of calculated data shall include the following:
- 1) General Data
 - a) Overcurrent protection device location, manufacturer, type, range of adjustment, IEEE device number, CT ratio.
 - 2) Equipment evaluation
 - a) Recommended settings or device size.
 - b) Referenced time-current curve.
- e. Provide a written summary at the end of the Protective Device Settings Study, which shall include the following:
- 1) Selected equipment deficiencies.
 - 2) Results of coordination study.

- 3) Conclusions and recommendations.

2.3 ARC FLASH STUDY

- a. Perform an Arc Flash Hazard Study after short circuit and protective device setting recommendations have been completed, reviewed, and accepted by the Engineer. Perform the analysis under worst-case arc flash conditions for all modes of operation. Provide an analysis of all operating scenarios which will be or have been influenced by the proposed or completed additions to the subject system.
- b. The Arc Flash Hazard Study shall be performed in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.
- c. The Arc Flash Hazard Study shall include the following:
 - 1) Basic description, purpose, and scope of the study.
 - 2) One Line Diagram.
 - 3) Short Circuit Study.
 - 4) Protective Device Settings Study.
 - 5) Calculation methods and assumptions.
 - 6) Typical calculation.
 - 7) Evaluation summary spreadsheet.
 - 8) Conclusions and recommendations.
- d. Base Calculation: For each major part of the power distribution system, the following shall be determined:
 - 1) Flash hazard protection boundary.
 - 2) Limited approach boundary.
 - 3) Restricted approach boundary.
 - 4) Prohibited approach boundary.
 - 5) Incident energy level.
 - 6) Personal protection equipment (PPE) hazard/risk category.
 - 7) Type of PPE required.
- e. Produce arc flash warning labels that list items in Part C above and provide the following additional items:

- 1) Bus name.
 - 2) Bus voltage.
- f. Produce detail sheets that list items in Part C above and the following items:
- 1) Bus name.
 - 2) Upstream protective device name, type, and settings.
 - 3) Bus-to-line voltage.
- g. Produce arc flash evaluation summary sheet listing the following additional items:
- 1) Bus name.
 - 2) Upstream protective device name, type, and settings.
 - 3) Bus-to-line voltage.
 - 4) Protective device bolted fault current.
 - 5) Arcing fault current.
 - 6) Protective device trip/delay setting.
 - 7) Breaker opening time.
 - 8) Solidly grounded column.
 - 9) Equipment type.
 - 10) Gap.
 - 11) Arc flash boundary.
 - 12) Working distance.
 - 13) Incident energy.
 - 14) Required protective fire rated clothing type and class.
- h. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 40 cal/cm². Provide proposals to reduce energy levels.
- i. Provide a written summary at the end of the Arc Flash Hazard Study, which shall include the following.
- 1) Equipment manufacturer's information used to prepare study.

- 2) Assumptions made during study.
- 3) Copy of one line diagram.
- 4) Arc flash evaluations summary spreadsheet.
- 5) Bus detail sheets.
- 6) Arc flash warning labels printed in color on adhesive backed labels.

2.4 ARC FLASH WARNING LABELS

- a. Provide arc flash warning labels per NEC 110.16
- b. All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.

PART 3: EXECUTION

3.1 GENERAL

- a. Adjust relay and protective device settings according to reduce arc flash while maintaining coordination between downstream circuit breakers and the upstream main circuit breaker.
- b. Perform minor modifications to equipment as required to accomplish conformance with short circuit study.
- c. Notify Contractor in writing of required major equipment modifications.
- d. Provide laminated one-line diagrams (minimum size 11" x 17") to post on interior of electrical room doors.
- e. Provide arc flash warning labels on equipment as specified on this Section.

END OF SECTION

SECTION 16060
GROUNDING AND BONDING

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) The section includes requirements for grounding electrodes, equipment grounding and electrical bonding.

1.2 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.

- 2) Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Ground Rods (16060.G01).
 - 1) Ground rods shall be provided as shown on the drawings.
 - 2) Ground rods shall be copper clad.
 - 3) Ground rods shall be a minimum of 5/8 inch diameter.
 - 4) Ground rods shall be a minimum of 10 feet long.
- b. Compression Connectors (16060.C20).
 - 1) Compression connections shall be provided as shown on the drawings and as required for bonding end-use equipment.
 - 2) Compression connections shall be compress-deforming type, extruded copper material.
 - 3) Compression connections shall be tin electroplated for corrosion resistance.
 - 4) Compression connections shall be ring-type connectors. Forked connectors shall not be used on grounding conductors.
 - 5) Provide Burndy products, or approved equal.
- c. Welded Connections (16060.C10).
 - 1) Welded connections shall be provided as shown on the drawings and as required for bonding ground rods, re-bar, building steel and like connections on the grounding electrode system.
 - 2) Welded connections shall be exothermic welded type connection with materials and equipment manufactured by a single manufacturer for that purpose.
 - 3) Provide Cadweld products, or approved equal.
- d. Mechanical Connectors (16060.C21).
 - 1) Mechanical connectors shall be provided as shown on the drawings and as required for bonding to pipes.
 - 2) Mechanical connectors shall be UL 467 Listed, copper material.
 - 3) Mechanical connectors shall be sized to match the pipe being bonded.

- 4) Mechanical connector clamps shall permit parallel or 90° cable connection.
 - 5) Mechanical connectors installed below-grade shall include silicon bronze hardware.
 - 6) Provide Burndy GAR3902 series for above-ground installations, or approved equal.
 - 7) Provide Burndy GAR-BU series for below-grade installations, or approved equal.
- e. Ground Test Well (16060.G60).
- 1) Ground test wells shall be provided as shown on the drawings.
 - 2) Provide Utility Vault box type # 3VB-1012B, or approved equal.
 - 3) Provide Utility Vault traffic cover # 1/3 VCB-C1 cover with custom “GROUND” marking on cover, or approved equal.
- f. Ground Bars (16060.B01).
- 1) Ground bars shall be provided as shown on the drawings.
 - 2) Provide Cutler-Hammer model GBK21, GE model TGK42, Square D model PK27GTA, or approved equal.
- g. Ground Bushings (16060.B10).
- 1) Split bushing shall be insulated, zinc die cast steel.
 - 2) Bushing shall be sized by the Contractor for grounding conductor served.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General.
- 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
 - 2) Bond separately derived systems, including generators, to the grounding electrode system.
 - 3) Maintain equipment ground continuity throughout the facility by means of a grounding conductor routed in all raceways.
 - 4) Provide grounding conductors pursuant to Section 16121. Conductors shall be copper and shall be sized per the Drawings or the NEC, whichever is greater.

- 5) Provide ground bushings for all conduits that do not terminate in a hub type fitting and install at the source of power with a bonding conductor fastened to the ground bushing.
- 6) Provide ground bar kits as shown on the Drawings and where two (2) or more grounding conductors are terminated in a box or enclosure.
- 7) Install ground rods at the locations and in the number shown on the Drawings or per the NEC, whichever is greater.
- 8) Bond the grounding electrode system to all metallic water and wastewater piping.

b. Ground Bushings.

- 1) Provide a grounding type bushing with lug for connection of grounding conductor for conduits that originate from each motor control center section, switchboard, or panelboard:
 - a) Individually bond these raceways to the ground bus in the equipment.
- 2) Provide grounding type bushings with lug for a connection to a grounding conductor for all conduits which terminate at a cable tray.
- 3) Provide grounding type bushings with lugs for connection of grounding conductor at both ends of metallic conduit runs. Bond ground bushings to the grounding system.
- 4) Provide a green insulated wire-grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

c. Grounding Conductors.

- 1) Brush grounding conductors clean of debris before connections are made.
- 2) Strip insulated conductor insulation in a neat, workman like manner where insulated conductors are used.
- 3) Fasten all conductors securely.

d. Connections.

- 1) Install connectors according to the manufacturer's directions, using the proper dies, tools, molds, shots, loads, etc. designed specifically for this purpose.
- 2) Provide irreversible welded type connections to ground rods, re-bar, lightning protection box, building steel etc.
- 3) Provide compression connector type connections to end use equipment and bolt to the equipment using washers and split lock washers for secure fastening. Bolts shall be grade 5 for grounding connections and shall be tightened to the manufacturer's recommend torque.

e. Ground Test Wells.

- 1) Install ground test wells at locations shown on the Drawings.
- 2) Install ground test wells such that the cover is flush with finished grade.
- 3) Install the ground rod within the well six (6) inches below grade.
- 4) Provide a minimum of six (6) inches of well compacted, $\frac{3}{4}$ minus gravel installed beneath the ground well box.
- 5) Place backfill within the ground test well to allow room for test equipment to be connected to the ground rod.

END OF SECTION

SECTION 16070 HANGERS AND SUPPORTS

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes:
 - 1) This section includes requirements pertaining to electrical equipment anchoring and electrical equipment hanging and support.

1.2 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data.
 - 1) Pursuant to Section 01300 Submittal Procedures.

- 2) Manufacturer's data including materials of construction, equipment weight and related information for each item specified in PART 2 PRODUCTS.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Stainless Steel Hardware (16070.H01).
 - 1) Bolts shall be 316 or 304 stainless steel and sized for the load served and have a hex head unless specifically specified otherwise elsewhere.
 - 2) Nuts shall be 316 or 304 stainless steel hex nut.
 - 3) Washers shall be 316 or 304 stainless steel, USS pattern flat washers.
 - 4) Split lock washers shall be 316 or 304 stainless steel.
 - 5) Threaded rods and couplings shall be 316 or 304 stainless steel.
 - 6) Eye-bolts, u-bolts, bent-bolts and similar connecting hardware shall be 316 or 304 stainless steel.
- b. Galvanized Hardware (16070.H11).
 - 1) Bolts shall be hot dipped galvanized steel and sized for the load served and have a hex head unless specifically specified otherwise elsewhere.
 - 2) Nuts shall be hot dipped galvanized steel hex nut.
 - 3) Washers shall be hot dipped galvanized steel, USS pattern flat washers.
 - 4) Split lock washers shall be hot dipped galvanized steel.
 - 5) Threaded rods and couplings shall be hot dipped galvanized steel.
 - 6) Eye-bolts, u-bolts, bent-bolts and similar connecting hardware shall be hot dipped galvanized steel.
- c. Stainless Steel Anchors (16070.A01).
 - 1) Wedge or stud anchors installed in concrete or masonry shall be 316 or 304 stainless steel and sized for the load served.
 - 2) Toggle type fasteners shall only be used in hollow sheetrock wall. The wing part of the fastener may be mild steel, but the bolt shall be stainless steel.
- d. Galvanized Anchors (16070.A11).
 - 1) Wedge or stud anchors installed in concrete or masonry shall be hot dipped galvanized steel and sized for the load served.

- 2) Toggle type fasteners shall only be used in hollow sheetrock wall. The wing part of the fastener may be mild steel, but the bolt shall be hot dipped galvanized steel.
- e. Stainless Steel Beam Clamps (16070.B01).
 - 1) Beam clamps shall be 316 or 304 stainless steel and sized for the load served.
- f. Galvanized Beam Clamps (16070.B11).
 - 1) Beam clamps shall be hot dipped galvanized steel and sized for the load served.
- g. Galvanized Strut Channel (16070.S01).
 - 1) Galvanized strut channel shall be hot dipped galvanized after fabrication and shall be a minimum of 12 gauge.
 - 2) Galvanized strut channel shall have factory pre-drilled holes.
- h. Stainless Steel Strut Channel (16070.S16).
 - 1) Stainless steel strut channel shall be 316 or 304 stainless steel and shall be a minimum of 12 gauge.
 - 2) Stainless steel strut channel shall have factory pre-drilled holes.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General.
 - 1) Refer to Section 16050 Part 1.9, B for Plant Area Work requirements.
 - 2) Hardware shall be set to a torque as recommended by the manufacturer.
 - 3) Washers and split lock washers shall be installed on all bolts, threaded rods and anchors.
 - 4) Lead or plastic type anchors are prohibited from use on the project.
 - 5) When threaded rods are installed in drop-in type anchors, a washer, split lock washer and a jamb nut shall be installed at the anchor to ensure stability.
 - 6) When channel (strut) is installed as a hanger or support from threaded rod, washers, split lock washers and jamb nuts shall be installed on both sides of the strut to lock it in place.
 - 7) Cut ends of channel, strut, threaded rods or other cut fittings shall be filed smooth before installation.

- 8) Cut ends of hot dipped galvanized channel and strut shall be coated with three coats of cold galvanizing compound after the channel has been filed to prohibit rust.
- 9) Galvanized channel and strut shall only be installed indoors in non-corrosive areas. Stainless steel channel and strut shall be installed everywhere else including outdoors and in corrosive areas.
- 10) Concrete anchors shall be installed as per the manufacturer's directions and set using the manufacturer's supplied tool.
- 11) Threaded rod shall not extend more than one (1) inch beyond the channel, strut or other material it is supporting.
- 12) Hangers and supports shall be installed level and plumb.
- 13) Provide strut plastic end caps at the ends of all struts that are exposed to unintentional contact by personnel. Plastic end caps shall be safety yellow finish or color as directed by the OWNER.
- 14) Hangers and supports shall be installed per the National Electrical Code, Building Code and Structural Code and shall be designed to safely support the load. The ENGINEER may request the CONTRACTOR provide a copy of their design calculations for the seismic requirements and the load served.

END OF SECTION

SECTION 16071
SEISMIC RESTRAINTS FOR ELECTRICAL SYSTEMS

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes:
 - 1) This section includes requirements pertaining to seismic restraints for electrical equipment.

1.2 REFERENCED STANDARDS

- a. The following is a list of standards which may be referenced in this Section:
 - 1) American Society of Civil Engineers (ASCE)
 - a) ASCE 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a

linked index, table of contents, or bookmarks will be rejected as incomplete.

- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data.
 - 1) Pursuant to Section 01300 – Submittal Procedures.
 - 2) Manufacturer’s data including materials of construction, equipment weight and related information for each item specified in PART 2 PRODUCTS.
 - 3) Seismic calculations and drawings.

1.4 REQUIREMENTS

- a. This project shall comply with the current edition of the Oregon Structural Specialty Code, Oregon Electrical Specialty Code, and ASCE 7-16.
- b. The seismic restraints for the project shall be designed to the following standards:
 - 1) Seismic Design Category, as shown by the Structural Engineer’s Drawings.
 - 2) All electrical systems shall have an Importance Factor by the Structural Engineer’s Drawings.
- c. The following electrical systems shall be provided with engineered seismic restraints:
 - 1) Generators and automatic transfer switches
 - 2) Suspended and supported conduit systems.
 - 3) Transformers, floor mounted.
 - 4) For electrical system with an IP = 1.0 only, all electrical systems weighing over 400-lbs or more with a center of gravity 4-ft or higher.
 - 5) All electrical enclosures weighing more than 20 lbs. This shall include, but not be limited to, panelboards, control panels, general enclosures, and luminaires.
 - 6) All other Electrical Systems required by ASCE 7-16 and the Oregon Structural Specialty Code.
- d. The CONTRACTOR shall pay for and obtain the services of a licensed Structural ENGINEER in the State of Oregon. The ENGINEER shall provide the following:

- 1) Restraint, bracing, and anchorage calculations and details. These details shall be project specific. Typical bracing details for commonly used restraint systems shall be acceptable.
 - a) The details and calculations shall be suitable for a deferred submittal to the AHJ for the purposes of obtaining an electrical permit.
 - b) Number, size, capacity, and location of seismic restraints.
 - c) Backing material to be used in stud wall applications.
 - d) The details and calculations shall be suitable for installation by the CONTRACTOR.
- 2) The Structural ENGINEER shall provide shop drawings for review and approval by the ENGINEER and ARCHITECT. The shop drawings shall include:
 - a) Project-specific restraint details.
 - b) Project-specific calculations
 - c) Wet stamped/signed documents.
- 3) The Structural ENGINEER shall perform an on-site inspection of the seismic restraint installation performed by the CONTRACTOR. The Structural ENGINEER shall provide a written report of the inspection, including identifying any deficiencies. The report shall be submitted to the ENGINEER for review and approval. The inspection shall be performed by the ENGINEER prior to the bracing being covered. The CONTRACTOR shall bear the responsibility of scheduling this inspection.
 - a) The CONTRACTOR shall be responsible for installing all seismic restraints per the Structural ENGINEER's requirements. Make all corrections required by the Structural ENGINEER.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Seismic Restraints (260545.R01).
 - 1) Restraints shall be provided as directed by the Structural ENGINEER.
 - 2) Material type shall confirm with the requirements of 26 05 29 Hangers & Supports for Electrical Systems.
 - 3) Bracing shall utilize strut channel style systems. The use of cable type systems shall not be permitted.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General.

- 1) Install all restraints as directed by the Structural ENGINEER and as required by Code.

END OF SECTION

SECTION 16075
ELECTRICAL AND CONTROL IDENTIFICATION

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes
 - 1) Requirements for identification of electrical, safety, measurement, data, fire alarm, security, monitoring, control and related components and equipment.

1.2 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.

- 2) The initial submittal shall contain all the products, samples and data base specified. An initial submittal that does not contain all the specified data shall be returned as incomplete.
- e. Samples
 - 1) Provide a sample of each type and size of nameplate, label, tag and means of attachment specified for approval by the OWNER.
- f. Quality Assurance / Quality Control Submittals
 - 1) The CONTRACTOR shall be responsible for submitting a data base of all identification nameplates, labels, panel schedules and tags required for the Work. The data base shall be developed in the most current edition of Microsoft Excel for the OWNER's future use.
- g. Closeout Submittals
 - 1) Pursuant to Section 01780 – Closeout Submittals.
 - 2) As-built electronic copy of the identification Excel data base.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Circuit Breaker Panel Schedules (16075.S21).
 - 1) Shall be created in Microsoft Excel software. One copy of each schedule shall be included in the closeout submittals.
 - 2) Shall be printed on 60 - 70 lb white card stock.
- b. Heat Sealing Lamination Products (16075.L11).
 - 1) Provide documents in laminate when specified. Laminate shall be clear, non-yellowing and sized for various sized documents.
 - 2) Shall be 5 mil in thickness.
- c. Velcro (16075.V15).
 - 1) Provide white Velcro.
- d. Plastic Nameplates (16075.P05).
 - 1) Shall have a black background with white engraved letters. Nameplates for emergency functions shall be red background with white engraved letters. The nameplates shall have self adhesive rated for the environment which they are installed. The font type shall be consistent on all nameplates.

- 2) Provide products supplied by E.R. Perry Signs & Engraving, or approved equal.
- e. Stainless Steel Nameplates (16075.S15).
- 1) Shall be 316 or 304 stainless steel.
 - 2) 1.5 inches high by 6.0 inches long minimum.
 - 3) The nameplate shall be between .025 - .050 inches thick.
 - 4) Text shall be as large as possible, shall be center justified and shall be stamped.
 - 5) The stainless steel nameplate shall be attached with stainless steel rivets. No less than four (4) rivets shall be used to securely fasten the nameplate.
 - 6) Provide products supplied by E.R. Perry Signs & Engraving, or approved equal.
- f. Stainless Steel Component and Device Tags (16075.S25).
- 1) Shall be stainless steel.
 - 2) Two (2) inch round.
 - 3) The tag shall be between .025 - .050 inches thick.
 - 4) The text shall be center justified and shall be stamped.
 - 5) Standard size for characters shall be 0.25 inches high.
 - 6) The stainless steel tags shall be attached to devices with stainless steel beaded chain which shall be provided with two (2) to three (3) inches of slack when the tag is attached to the device. The hole in the tag for the beaded chain shall be at the top and centered on the tag. The hole shall be large enough that the chain will not bind in the hole.
 - 7) Provide products supplied by E.R. Perry Signs & Engraving, or approved equal.
- g. Conduit Tags (16075.S35).
- 1) Shall be 316 or 304 stainless steel.
 - 2) Nominally 0.75 inches high by 3.0 inches long.
 - 3) Characters shall be 0.25 inches high. And shall be machine punched or durably embossed.
 - 4) Conduit tags shall be products readily available and manufactured for this purpose.
 - 5) The stainless steel conduit tags shall be attached with stainless steel cable ties.

- 6) Provide Panduit Permanent Identification System products, or approved equal.
- h. Epoxy Gel (16075.E05).
 - 1) Shall be a two component, 100 % solids, moisture tolerant, high modulus, high strength, structural epoxy paste adhesive.
 - 2) Provide Sika type Sikadur 31, Hi-Mod Gel, or approved equal.
- i. Conduit Trench Marker Tape (16075.T21).
 - 1) Shall be a minimum of six (6) inches wide, polyethylene tape manufactured for this purpose.
 - 2) Color code for tape shall be as listed below and the verbiage on the tape shall identify the type of system i.e. "Caution Buried Electric Line Below".
 - a) Electric Power – RED
 - b) Fiber Optic – ORANGE
 - c) Data/Phone – ORANGE
 - d) Control – ORANGE
 - 3) Provide products manufactured by Seaton Identification Products, Harris Industries, or approved equal.
- j. Conductor and Cable Identification Sleeves (16075.T31).
 - 1) The identification sleeves shall be properly sized for the cable or conductor.
 - 2) Sleeves shall be white with black machine generated characters.
 - 3) Provide Brady wire and cable sleeves, or approved equal.
- k. Flexible Identification Tape (16075.T56).
 - 1) Shall be white, red, yellow, clear or as otherwise specified tape with black characters.
 - 2) Standard tape size shall be 0.5 inch high unless specified otherwise and shall have extra strength adhesive rated for indoor and outdoor use.
 - 3) Provide products manufactured by Brother, or approved equal.
- l. Colored Tape (16075.T73).
 - 1) Shall be rated for adhesion to steel and PVC conduits.
 - 2) Shall be two (2) inches wide nominal and available in the colors specified.
 - 3) Shall have extra strength adhesive rated for indoor and outdoor use.
 - 4) Color code for tape shall be as listed below.

- a) Fire Alarm / Life Safety - RED
 - b) Fiber Optic – ORANGE
 - c) IT Data/Phone – BLUE
 - d) Generator power – ORANGE
- 5) Provide DUCK, 3M, or approved equal.
- m. Safety Paint (16075.P36).
 - 1) Provide yellow – IP84 Safety Yellow paint.
 - 2) Reference Section 09900 – Paint for additional specification requirements.
- n. Arc Flash Labels (16075.A11).
 - 1) Reference Section 16057 – Electrical Systems Analysis for additional details.
 - 2) Shall be self adhesive and manufactured specifically for this purpose.
 - 3) Shall be four (4) inches high by six (6) inches wide minimum.
 - 4) Shall be based on the latest edition requirements of the National Fire Protection Association (NFPA) 70E – Standard for Electrical Safety.
 - 5) At a minimum the label shall contain the following information.
 - a) Date calculation was performed and who did the calculation.
 - b) Danger or Warning level based on the incident energy. When above 40 cal/cm sq. the label shall read “Danger”.
 - c) Shall identify the hazard as being both arc flash and shock hazard.
 - d) Shall clearly state the incident energy and the level of personal protective equipment (PPE) required.
 - e) Provide labels manufactured by Dura Label, SKM System Analysis, Inc., or approved equal.
- o. Conductor Color Coding (16075.C89).
 - 1) Conductors shall be colored as specified in the table below. The technical specification requirements for the conductors are specified elsewhere.

Conductor Color Coding

System	Conductor	Color
All Systems	Equipment Grounding	Green
IT / Data	Data Cable Sheath (outer cover)	Blue
24 Volt DC	Positive	Blue
	Negative	White w/ Blue Stripe
	Discrete Input Line (hot leg) Side	Blue
	Discrete Input Switch Leg	Blue w/ White Stripe
	Discrete Output Line (hot leg) Side	Blue
	Discrete Output Switch Leg	Blue w/ Orange Stripe
24 Volt AC	Hot Leg	Red
	Neutral	White
	Discrete Input Line (hot leg) Side	Red
	Discrete Input Switch Leg	Red w/ Blue Stripe
120 Volt AC Control	Hot Leg	Red
	Neutral	White
	Discrete Input Line (hot leg) Side	Red
	Discrete Input Switch Leg	Red w/ White Stripe
	Discrete Output Line (hot leg) Side	Red
	Discrete Output Switch Leg	Red w/ Orange Stripe
120/240 Volt Single Phase	Hot Leg # 1	Black
	Hot Leg # 2	Red
	Neutral	White
120/208 Volt Three Phase	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral	White
120, 208, 277 Volt	Switch Legs	Pink
480 Volt Three Phase	Phase A	Brown
Wye or Delta Corner Tap	Phase B	Purple
	Phase C	Yellow
	Neutral	Gray
120/240 Delta Three Phase	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
	Neutral	Gray

PART 4: EXECUTION

4.1 INSTALLATION

a. Circuit Breaker Panel Schedules

- 1) CONTRACTOR shall request panel schedules in Microsoft Excel software and printing instructions from ENGINEER. CONTRACTOR shall update the panel schedules to reflect as-built conditions. Print schedules on 60 - 70 lb white card stock with black ink.
- 2) Schedules shall be neatly trimmed with 1/8" white space borders.
- 3) The finished schedules shall be laminated and neatly trimmed with 1/8" of laminate border.
- 4) A sample layout shall be submitted to OWNER for approval prior to installation.
- 5) Attach white Velcro to the panel door and the back of the panel schedule. Velcro shall, at a minimum, be attached to all four corners of the panel schedule.

b. Plastic Nameplates

- 1) Provide plastic nameplates for panelboards, motor control centers, motor starters, disconnects, variable frequency drives, control panels and similar equipment. The verbiage on the nameplate shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available on the Contract Drawings.
- 2) In addition to the nameplate identifying the equipment, a second nameplate shall be provided that identifies the source of power for the equipment i.e. "Fed From PNL208-1".
- 3) Typically the nameplates shall be centered and installed near the top of the equipment.
- 4) Nameplates shall be black with white characters unless specified otherwise.
- 5) Nameplates on emergency panels shall be red with white characters.

c. Stainless Steel Nameplates

- 1) Provide stainless steel nameplates for in-ground boxes, cast-in concrete boxes, electrical boxes larger than four (4) inches in any direction, boxes installed outdoors and vaults.
- 2) The nameplates shall be installed on the lid/cover and attached with 1/8 inch, stainless steel rivets in all four corners at a minimum.

- 3) The verbiage on the nameplate shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available on the Contract Drawings.
- d. Stainless Steel Component and Device Tags
- 1) Provide stainless steel component and device tags for instruments, valves, pipes and similar equipment.
 - 2) The tag shall be attached with a stainless steel beaded chain and attached in a manner and location which enables it to be read without interfering with the operation of the component or device. Whenever possible it shall not be attached to a removable part of the equipment.
 - 3) The verbiage on the tag shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available on the Contract Drawings.
- e. Conduit Tags
- 1) Provide stainless steel conduit tags at each point that a conduit terminates at or within an enclosure or box. The stainless steel tag shall be attached with stainless steel cable ties.
 - 2) Where conduits enter a vault and are installed flush with the walls, the conduit tag shall be installed directly above the conduit entry and attached to the wall of the vault with epoxy gel.
 - 3) The verbiage on the tag shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available on the Contract Drawings.
 - 4) Where conduits terminate at a box in an inaccessible location such as behind a sheetrock wall, conduit labels are not required.
- f. Conduit Trench Marker Tape
- 1) Provide conduit trench marker tape for single or multiple buried conduits. The color and verbiage shall match the type of system installed. If the trench contains several systems, one of which is electric power, the tape shall be for electric power.
 - 2) The tape shall be installed 12 inches below finished grade and shall be laid flat and parallel to the conduits.
- g. Conductor and Cable Identification Sleeves
- 1) Provide heat shrink, machine generated, white labels with black characters for all cables and conductors. Explanation is provided below on how various systems shall be identified. In many cases the information necessary to develop the unique identification labels will be provided on the Contract Drawings. The

verbiage required for the identification shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available or clear based on the information provided on the Contract Drawings.

- 2) The labels shall be installed between 6 to 8 inches from the end and shrunk. Conductors shall be labeled at all splices and points of termination.
- 3) Power conductors and cables, including the neutral and the ground conductors shall all be identified individually. The identification label will be developed as follows: The first set of characters will be the equipment code identifying the source of power "PNL208" followed by the circuit number "CKT 12" and a forward slash followed by the room number where the utilization is located and then the utilization equipment. Using the first sequential unit heater in room 2334 as an example, the label would read "PNL208-CKT 12/ 2334-UH-1".
- 4) Control conductors, including grounds, shields, etc. shall be identified individually. The label shall identify the point of origin and the utilization equipment it serves. The identification label will be developed as follows: An sample label for a conductor fed from terminal strip 2, terminal block 33 in control panel # 1 (CP-1) to an terminal strip 1, terminal block 4 in automatic transfer switch # 1 (ATS-1) would read CP-1 TS2-TB33 / ATS-1 TS1-TB4.
- 5) Security conductors and cables shall be identified in the same manner as control conductors.
- 6) Fire alarm and life safety conductors and cables shall be identified in the same manner as control conductors.
- 7) Direct Digital Control (DDC) conductors and cables shall be identified in the same manner as control conductors.
- 8) Local Area Network (LAN) cables shall be identified with the rod mount number, highband number and the network room number from which it is connected. The verbiage required for the identification shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available or clear based on the information provided on the Contract Drawings.
- 9) Telephone, cameras, speakers and other IP cables connected to the LAN shall be identified in the same manner as the LAN cables.

h. Device and Faceplate Identification Labels

- 1) Devices, faceplates, security devices, fire alarm & life safety devices, small electrical boxes 4 inches or less located indoors and similar equipment shall be identified utilizing flexible identification tape. Typically the CONTRACTOR shall provide machine generated, white labels with black characters except as specified otherwise. Explanation is provided below on how various systems shall be identified. In many cases the information necessary to develop the unique

identification labels will be provide on the Contract Drawings. The verbiage required for the identification shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available or clear based on the information provided on the Contract Drawings.

- 2) LAN faceplates and device shall be identified in the upper information window by the network room number that serves it. Each data jack shall be labeled individually and the label shall include the rod mount and highband number. An individual data jack fed from rod mount 2, highband 34 would read "2.34".
- 3) Power receptacles faceplates (cover plates) shall state the panel and circuit number. A typical label might read "PNL208-1-CKT 15".
- 4) Light switches faceplate shall state the panel and circuit number(s). A typical label might read "PNL208-2-CKT 15&17".
- 5) Light fixture labels shall be attached adjacent to the ballast and shall follow the same requirements of listing the panel and circuit number. A typical label might read "PNL480-1-CKT 9&11".
- 6) Interior emergency light fixtures shall have a unique 0.5 inch adhesive dot applied to facilitate tracking routine maintenance required for emergency lighting. The dots shall be red when they have an integral battery back-up and orange when fed from an emergency panel powered by a generator.
- 7) Exterior light fixtures shall be uniquely identified to facilitate tracking of routine maintenance. The identification shall be shown on the Contract Drawings. The identification label will be developed as follows: The first set of characters will be the facility code "SLC-012" followed by the equipment code "LGT" and then a sequence number such as "14". A typical label might read "SLC-012-LGT-14". The labels shall be self adhesive, yellow vinyl with black characters. The label shall be installed on the bottom of the fixture when mounted 5 feet above finished grade (AFG) or higher and on the top when mounted lower than 5 feet. Labels shall be 0.5 inches high with 0.375 inch characters when mounted lower than 10 feet AFG. Labels shall be 0.75 inches high with .0.5 inch characters when mounted between 10 and 20 feet. Labels shall be 1.0 inches high with .0.75 inch characters when mounted higher than 20 feet AFG.
- 8) Security Cameras, keypads, door switches, motion detectors, etc. shall be identified as shown on the Contract Drawings. The identification label will be developed as follows: The first set of characters will be the facility code "SLC-061" followed by the room number (2334) and then the equipment code "KEY" and lastly by a sequential number such as "21". A typical label might read "SLC-061-2334-KEY-21".
- 9) Fire alarm / life safety devices such as pull stations, door magnets, horns, beacons, etc. shall be identified as shown on the Contract Drawings. The identification label will be developed as follows: The first set of characters will be the facility code "SLC-032" followed by the room number (2334) and then the

equipment code “PS” and lastly by a sequential number such as “11”. A typical label might read “SLC-032-2334-PS-11”.

- 10) Direct digital control components and accessories such as dampers, actuators, VAV, etc. shall be identified as shown on the Contract Drawings. The identification label will be developed as follows: The first set of characters will be the facility code “SLC-007” followed by the room number (2334) and then the equipment code “VAV” and lastly by a sequential number such as “43”. A typical label might read “SLC-007-2334-VAV-43”.

i. Colored Tape

- 1) Colored tape shall be installed on conduits used for the systems listed below. The tape shall have extra strength adhesive rated for indoor and outdoor use and two (2) inches wide. CONTRACTOR shall install a single wrap around the circumference of the conduit at five (5) foot intervals. In addition the exterior of junction or pull boxes installed along these raceways shall be painted entirely with 2 coats of paint that matches the tape color.
 - a) Fire alarm / life safety – RED
 - b) Data / IT – BLUE
 - c) Fiber Optic – ORANGE
 - d) Generator power routed to or from emergency panels – ORANGE

j. Safety Paint

- 1) The CONTRACTOR shall paint a two (2) inch wide line of safety yellow paint on the floor outlining the minimum working clearances around circuit breaker panels, switch boards, transformers, and similar equipment as defined by the National Electrical Code (NEC). The lines shall be along the front, sides and back of the equipment as the NEC dictates. The paint shall be applied per Section 09900 – Paint and shall be squared off and parallel and perpendicular to the equipment.
- 2) The CONTRACTOR shall review the requirements for each individual piece of equipment with the ENGINEER before installing.

k. Arc Flash Labels

- 1) The CONTRACTOR shall install arc flash labels on all electrical equipment as required by the NEC and National Fire Protection Association (NFPA) 70E – Standard for Electrical Safety. The minimum requirements for the labels are itemized in PART 2 Products.
- 2) The CONTRACTOR shall be responsible for providing the coordination study and arc flash analysis necessary to calculate the incident energy and personal protective equipment (PPE) data required on each label.
- 3) An as-built coordination study and arc flash analysis shall be prepared at the Contractor’s expense and be performed by a Professional Engineering licensed in the State of Oregon. The calculations shall utilize SKM Power Tools software

and an electronic and hard copy shall be submitted to the Owner for approval. Arc Flash Labels with all data specified by the current edition of the NFPA 70E (Standard for Electrical Safety) and Occupational Safety & Health Administration (OSHA) shall be provided by the Contractor.

- 4) The CONTRACTOR is responsible to make the adjustments to the protective devices and circuit breakers as specified in the coordination study.

END OF SECTION

SECTION 16080 ELECTRICAL TESTING

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes
 - 1) Electrical and control testing forms and requirements.

1.2 SEQUENCING

- a. ENGINEER shall issue written acceptance of the following certifications submitted by the CONTRACTOR before utility power is supplied to conductors, cables, or equipment.
 - 1) Megger Test
 - 2) Continuity Test
 - 3) Calibration Certification Test
 - 4) Motor Insulation Test
- b. CONTRACTOR shall verify to ENGINEER that every function of the electrical, measurement, and control systems are operating properly.

PART 2: PRODUCTS – NOT USED

PART 3: EXECUTION

3.1 FIELD QUALITY CONTROL

- a. Site Tests, Inspection
 - 1) CONTRACTOR shall be responsible to become familiar with the test and certification requirements of the Contract Documents for this project. It is the intent of these requirements that the Work will be systematically checked to verify that the functions required or implied, work properly to insure safety for the personnel, environment, and equipment associated with the Work.
 - 2) CONTRACTOR shall complete the certification forms that are supplemental to this section and submit the forms to ENGINEER for approval.
 - 3) All site test and inspection certificates and schedules shall be contained in a 3-ring binder(s).
 - a) Size 8½ inches by 11 inches.
 - b) Paper: 20-pound minimum, white for typed pages.
 - c) Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.

- d) Provide each manual with title page to include "Process Electrical Testing", typed table of contents with consecutive page numbers. Where more than one binder is used, consecutively title each with a volume number. The first binder shall be labeled Volume 1 and consecutively numbered as required to include all test documentation.
 - e) Tab sections for each required section of testing and acceptance certification.
- 4) CONTRACTOR shall notify ENGINEER seven days in advance of scheduled testing and facilitate the witnessing of those tests by ENGINEER.
- 5) CONTRACTOR shall provide ENGINEER with current as-built documentation for electrical and measurement and control commissioning with submittal of test certification.
- a) Systems operating at or above 200-volts to ground or more shall be included in the Megger Test Certification. Minimum duration for each test shall be one minute, at 1000 VDC, and minimum acceptable results shall be 50 mega ohms.
 - b) Conductors and cables shall be included in the Continuity Test Certification. No continuity to ground is the only acceptable result of the test.
 - c) Conductors, cables, or equipment failing to meet the minimum requirements shall be replaced with new. Repair will not be acceptable.
 - d) Each individual instrument shall have an Instrument Calibration Certificate. The calibration shall operate within the tolerances specified by the manufacturer of the instrument and the Contract Documents.
 - e) Installed motors shall have a written Motor Insulation Certificate for all the motors listed in the Drawings for the Work. Motors failing test shall be tagged and locked out from operation.

3.2 SUPPLEMENTS

- a. Schedule 16080 - A; Megger Test Certificate.
- b. Schedule 16080 - B; Continuity Test Certificate
- c. Schedule 16080 - C; Instrument Calibration Certificate.
- d. Schedule 16080 - D; Motor Insulation Test Certificate.

END OF SECTION

SUPPLEMENT 16080 - A
MEGGER TEST CERTIFICATE

				Project Number:					
Test Equipment Manufacturer:		Model Number:		Project Name:					
Test Equipment Last Calibration Date:		Serial Number:		Accepted By:					
				Date:					
Testing Personnel:		Calibration Certificate		Drawing Reference:					
Test Voltage:		Test Date:		Title:					
				Tag:					
Title	Tag Identification	A-Ø/ B-Ø	A- Ø / C- Ø	A- Ø / Ground	B- Ø / Ground	C- Ø / Ground	A- Ø / Neutral	B- Ø / Neutral	C- Ø / Neutral

SUPPLEMENT 16080 - A
MEGGER TEST CERTIFICATE

				Project Number: <i>12345</i>					
Test Equipment Manufacturer: <i>APC</i>		Model Number: <i>GH-1</i>		Project Name: <i>Water Diversion</i>					
Test Equipment Last Calibration Date: <i>8/13/02</i>		Serial Number: <i>346321</i>		Accepted By: <i>S.E. Davis</i> Date: <i>01/01/2003</i>					
Testing Personnel: <i>John Doe</i>		Calibration Certificate: <i>Yes</i>		Drawing Reference: <i>E-006</i>					
Test Voltage: <i>1000 Volts</i>		Test Date: <i>12/17/02</i>		Title: <i>Power Distribution Diagram</i>					
				Tag: <i>016</i>					
Title	Tag Identification	A-Ø/ B-Ø	A- Ø / C- Ø	A- Ø / Ground	B- Ø / Ground	C- Ø / Ground	A- Ø / Neutral	B- Ø / Neutral	C- Ø / Neutral
<i>Main Feeder</i>	<i>016-CO3</i>	∞	∞	∞	∞	∞	∞	∞	∞
<i>PNL-07</i>	<i>016-CO7</i>	∞	∞	∞	∞	∞	∞	∞	∞
<i>PNL-12</i>	<i>016-C12</i>	∞	∞	∞	∞	∞	∞	∞	∞

END OF SUPPLEMENT

SUPPLEMENT 16080 - B
CONTINUITY TEST CERTIFICATE

				Project Number:	
Test Equipment Manufacturer:		Model Number:		Project Name:	
Test Equipment Last Calibration Date:		Serial Number:		Accepted By:	
Testing Personnel:		Calibration Certificate:		Date:	
		Test Date:		Drawing Reference:	
				Title:	
				Tag:	
Permanent Tag Number	Function	Temporary Tag Number	Device ID Number	Ohms to Ground	

SUPPLEMENT 16080 - B
CONTINUITY TEST CERTIFICATE

				Project Number: <i>12345</i>
Test Equipment Manufacturer: <i>Fluke</i>		Model Number: <i>53G</i>		Project Name: <i>Water Division</i>
Test Equipment Last Calibration Date: <i>Unknown</i>		Serial Number: <i>638842</i>		Accepted By: <i>S.E. Davis</i> Date: <i>01/01/2003</i>
Testing Personnel: <i>John Doe</i>		Calibration Certificate: <i>No</i>		Drawing Reference: <i>E-501</i>
		Test Date: <i>12/30/02</i>		Title: <i>Conduit Schedule</i>
Permanent Tag Number	Function	Temporary Tag Number	Device ID Number	Ohms to Ground
<i>016-34-PNL</i>	<i>Level Indicator</i>	<i>34</i>	<i>016-34</i>	∞

END OF SUPPLEMENT

SUPPLEMENT 16080 - C
INSTRUMENT CALIBRATION CERTIFICATE

Component:			Manufacturer:			Project Number:					
Name:			Name:			Project Name:					
			Model:								
☐ Analog ☐ Digital											
		Range	Value	Units	Computing Functions? ☐ Y ☐ N		Control? ☐ Y ☐ N				
Indicate? ☐ Y ☐ N		Chart:			Describe:		Action? ☐ Direct ☐ Reverse				
Record? ☐ Y ☐ N		Scale:					Switch? ☐ Y ☐ N				
Transmit? ☐ Y ☐ N		Input:					Unit Range:				
Convert? ☐ Y ☐ N		Output:					Differential: ☐ Fixed ☐ Adjustable				
							Rest? ☐ Automatic ☐ Manual				
Required			As Calibrated				Required		As Calibrated		
Input %	Indicated	Output	Increasing input		Decreasing Input		#	Trip Pt	Reset Pt	Trip Pt	Reset Pt
			Indicated	Output	Indicated	Output		(Note Rising or Falling)		(Note Rising or Falling)	
							1				
							2				
							3				
							4				
#	Notes: Describe Test Results/List Any Failed Components							Instrument Calibration Acceptance			
								By:			
								Date:			
								☐ Accepted ☐ Rejected			
								Loop Title:			
								Loop Number:			

SUPPLEMENT 16080 - C
INSTRUMENT CALIBRATION CERTIFICATE

Component: <i>FIT & FE-200</i>			Manufacturer: <i>Rosemount</i>			Project Number: <i>12345</i>				
Name: <i>Main Line Flow Meter</i>			Name: <i>Magnetic Flow Meter</i>			Project Name: <i>Water Diversion</i>				
			Model: <i>53H</i>							
☐ Analog							☐ Digital			
		Range	Value	Units	Computing Functions? ☐ Y ☐ N		Control? ☐ Y ☐ N			
Indicate? ☐ Y ☐ N		Chart: <i>0-400</i>	GPM		Describe:		Action? ☐ Direct ☐ Reverse			
Record? ☐ Y ☐ N		Scale: <i>N/A</i>					Switch? ☐ Y ☐ N			
Transmit? ☐ Y ☐ N		Input: <i>4-20</i>	MA				Unit Range: 0-400 GPM			
							Differential: ☐ Fixed ☐ Adjustable			
Convert? ☐ Y ☐ N		Output: <i>N/A</i>					Rest? ☐ Automatic ☐ Manual			
Required			As Calibrated				Required		As Calibrated	
Input %	Indicated	Output	Increasing input		Decreasing Input		#	Trip Pt	Reset Pt	Trip Pt Reset Pt
<i>0</i>	<i>0 GPM</i>	<i>4 mA</i>	<i>Indicated</i>	<i>Output</i>	<i>Indicated</i>	<i>Output</i>		(Note Rising or Falling)		(Note Rising or Falling)
<i>25</i>	<i>100 GPM</i>	<i>8mA</i>	<i>100 GPM</i>	<i>8mA</i>	<i>101 GPM</i>	<i>8.05mA</i>	1	<i>N/A</i>	<i>N/A</i>	<i>N/A</i> <i>N/A</i>
<i>50</i>	<i>200 GPM</i>	<i>12mA</i>	<i>200 GPM</i>	<i>12.01mA</i>	<i>201 GPM</i>	<i>12.05mA</i>	2			
#	Notes: Describe Test Results/List Any Failed Components						Instrument Calibration Acceptance			
							By: <i>S.E. Davis</i>			
							Date: <i>12/16/02</i>			
							☐ Accepted ☐ Rejected			
							Drawing Reference: <i>I-802</i>			
							Loop Title: <i>Flowmeter</i>			
							Loop Number: <i>016 FIT-200</i>			

END OF SUPPLEMENT

SUPPLEMENT 16080 - D

MOTOR INSULATION TEST

[illegible]

SUPPLEMENT 16080 - D
MOTOR INSULATION TEST

Test Equipment Manufacturer: <i>APC</i>		Model Number: <i>GH-1</i>	Project Number: <i>12345</i>	
Test Equipment Last Calibration Date: <i>11/3/02</i>		Serial Number: <i>346321</i>	Project Name: <i>Water Diversion</i>	
Testing Personnel: <i>John Doe</i>		Calibration: <i>Yes</i>	Accepted By: <i>S.E. Davis</i>	
		Test Date: <i>12/20/02</i>	Date: <i>1/1/03</i>	
		Drawing Reference: <i>E-202</i>		
Motor Serial #	Equipment ID #	T-Lead #1/Ground	T-Lead #2/Ground	T-Lead #3/Ground
<i>GE - 346332</i>	<i>Sewage pump No. 1</i>	∞	∞	∞
<i>GE - 346331</i>	<i>Sewage pump No.2</i>	∞	∞	∞
<i>GE - 346330</i>	<i>Sewage pump No. 3</i>	∞	∞	∞
<i>GE - 346333</i>	<i>RAS pump No. 1</i>	∞	∞	∞
<i>GE - 346334</i>	<i>RAS pump No. 2</i>	∞	∞	∞

END OF SUPPLEMENT

SECTION 16095
MINOR ELECTRICAL DEMOLITION

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) Removal of existing electrical equipment, wiring and conduit in areas to be remodeled. Removal of designated construction, dismantling, cutting and alterations for completion of the Work.
 - 2) Disposal of materials.
 - 3) Storage of removed materials.
 - 4) Identification of utilities.
 - 5) Salvaged items.
 - 6) Protection of items to remain as identified in the schedules at the end of this Section.
 - 7) Relocate existing equipment.
 - 8) Removal of temporary electrical equipment prior to completion of the Work.

1.2 CLOSEOUT SUBMITTALS

- a. Refer to the Contract Documents for general closeout submittal requirements.
- b. Project Record Drawings shall be provided that record actual locations of capped conduits and equipment abandoned in place.

1.3 SEQUENCING

- a. Sequencing of the Work shall be as noted in the Contract Documents.

1.4 SCHEDULING

- a. Refer to the Contract Documents.
- b. Coordinate the schedule of noisy, malodorous and dusty work with the ENGINEER.

1.5 COORDINATION

- a. Refer to Contract Documents.
- b. Conduct demolition to minimize interference with adjacent or occupied areas.

- c. Coordinate demolition work with other trades.
- d. Coordinate and sequence demolition so as not to cause shutdown or interruption of operation of surrounding areas.
- e. Arrange timing of shutdowns with the OWNER. Do not shutdown any utility service without prior written approval. Keep shutdown periods to a minimum.
- f. Identify salvage items in cooperation with the OWNER.

PART 2: PRODUCTS – NOT USED

PART 3: EXECUTION

3.1 EXAMINATION

- a. Verify wiring and equipment scheduled for demolition serve only abandoned process and facilities.
- b. Verify termination points for demolished services.

3.2 DEMOLITION

- a. Items scheduled for demolition shall be legally disposed of by the CONTRACTOR.
- b. Remove exposed abandoned conduit.
- c. Disconnect electrical systems in walls, floors and ceilings scheduled for removal.
- d. Reconnect equipment being disturbed by renovation work and required for continued service.
- e. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, switches, receptacles, conduit, and conductors which are not part of the completed project.
- f. Install temporary wiring and connections necessary to maintain existing systems in service during construction.
- g. Remove, relocate and extend existing installations to accommodate new construction.
- h. Repair adjacent construction and finishes to original condition that are damaged during demolition and extension work.
- i. Remove abandoned grounding and bonding components, fasteners, supports and electrical identification components. Cut embedded support elements flush with wall, floors and ceilings.
- j. Clean and repair existing equipment scheduled to be reinstalled.
- k. Protect and retain power to existing active equipment remaining.

- l. Cap abandoned empty conduit at both ends.
- m. Provide water-tight, knockout seals in panels, enclosures, gutters, or junction boxes where conduit has been removed.
- n. Seal concrete penetrations, originally occupied by removed conduit, with suitable grouting material.

3.3 EXISTING PANELBOARDS

- a. Trace out circuits in existing panelboards and document the as-built conditions, including what each circuit feeds, the size of the conductors for each circuit and the total volt-amp load on each circuit.
- b. Remove all unused conductors due to scheduled demolition.
- c. Provide as-built panel schedules at the completion of the Work.

3.4 SALVAGE ITEMS

- a. Remove and protect items scheduled to be salvaged. Coordinate with OWNER the final location of these items.

3.5 REUSEABLE ELECTRICAL EQUIPMENT

- a. Unless specifically identified for reuse, no used electrical equipment, conduit, conductors, components of any sort scheduled for demolition, disposal or salvage shall be installed for reuse on the project.
- b. Electrical equipment identified specifically as being reused on the project shall be cleaned and protected until such time as it is reinstalled.

3.6 SCHEDULES

- a. Salvage the following equipment to the OWNER at a location they identify. Coordinate the delivery of the salvaged items to the location identified by the OWNER at a time they have pre-approved.
 - 1) Coordinate with OWNER on electrical equipment that shall be salvaged versus disposed.
- b. Dispose of the following equipment and its associated components.
 - 1) Coordinate with OWNER on electrical equipment that shall be disposed.
 - 2) Existing Shop / Lab Building
 - a) Demolish existing service and meter at the lab.
 - (1) Coordinate shutdown with the OWNER and electric service utility (PP&L).

- 3) Existing Irrigation / Chlorine Building.
 - a) Demolish existing service at the irrigation pump station.
 - (1) Coordinate shutdown with the OWNER and electric service utility (PP&L).
 - b) Demolish existing main circuit breaker.
 - c) Demolish existing power gutter.
 - d) Demolish existing irrigation pump control panel.
 - e) Demolish existing 15kVA transformer.
 - 4) Existing De-Chlorination Building.
 - a) Demolish the existing unit heater.
- c. Reuse the following items.
- 1) Existing Irrigation / Chlorine Building.
 - a) Reuse existing irrigation pumps and repurpose as the DAF Sludge Pump and Irrigation Pump #3 as shown on the Drawings.
 - b) Reuse existing irrigation flowmeter and re-label as FIT-3131 and wire back to CP-3000 as shown on the Drawings.
 - c) Reuse existing pressure switches on the Sludge Pipe Flushing Pump pipeline. Re-label as PSH-3151 and PSL-3152 and wire back to CP-3000 as shown on the Drawings.
 - 2) Existing De-Chlorination Building.
 - a) Reuse existing panelboard and service.
 - b) Reuse 120VAC circuits for the SO2 equipment as shown on the Drawings.

END OF SECTION

SECTION 16121
600 VOLT CONDUCTORS AND CABLES

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) The section includes the requirements for conductors and cables used to conduct potentials of 600 volts and less.
 - 2) All conductors and cables shall be installed in conduit or approved raceways regardless of which Division the conductors or cables are specified.

1.2 REFERENCES

- a. The following is a list of Standards which may be referenced in the Section.
 - 1) American Society for Testing and Materials (ASTM).
 - a) B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
 - 2) National Electrical Contractors Association, Inc. (NECA): National Electrical Installation Standards (NEIS).
 - 3) National Electrical Manufacturers Association (NEMA).
 - a) WC 3, Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - b) WC 5, Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - c) WC 7, Cross Linked-Thermosetting Polyethylene Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - d) WC 55, Instrumentation Cables and Thermocouple Wire.
 - 4) National Fire Protection Association (NFPA). 70, National Electrical Code (NEC).
 - 5) Underwriters Laboratories, Inc. (UL).
 - a) 13, Standard for Power-Limited Circuit Cables.
 - b) 44, Standard for Safety Rubber-Insulated Wires and Cables.
 - c) 62, Standard for Safety Flexible Cord and Fixture Wire.
 - d) 510, Standard for Safety Insulating Tape.
 - e) 854, Standard for Safety Service-Entrance Cables.
 - f) 910, Standard for Safety Test Method for Fire and Smoke Characteristics of Electrical and Optical Fiber Cables Used in Air Handling Spaces.
 - g) 1277, Standard for Safety Electrical Power and Control Tray Cables.
 - h) 1581, Standard for Safety References for Electrical Wires, Cables and Flexible Cords.

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.
 - 2) Manufacturer’s data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Single Copper Conductors (THHN / THWN-2) (16121.C01).
 - 1) THHN / THWN-2 type insulation shall be provided for all conductors #10 and #12 AWG lighting and receptacle branch circuits.
 - 2) Conductors shall be rated for 600 volts and conform to applicable requirements of NEMA.

- 3) Conductors shall be stranded copper.
 - 4) Insulation type shall be THWN-2.
 - 5) Conductors shall be sized per the Drawings and the NEC, whichever is greater.
 - 6) Rome Cable Corporation, Southwire Company, Okonite Company, or approved equal.
- b. Single Copper Conductors (XHHW / XHHW-2) (16121.C02).
- 1) XHHW / XHHW-2 type insulation shall be provided for all conductors #8 AWG and larger, including all process, motor, and pump load circuits, services, and feeders.
 - 2) Conductors shall be rated for 600 volts and conform to applicable requirements of NEMA.
 - 3) Conductors shall be stranded copper.
 - 4) Insulation type shall be XHHW / XHHW-2.
 - 5) Conductors shall be sized per the Drawings and the NEC, whichever is greater.
 - 6) Rome Cable Corporation, Southwire Company, Okonite Company, or approved equal.
- c. Twisted Shielded Pair (TSP) Cables (16121.T01).
- 1) TSP cable shall be rated for 600 volts and conform to applicable requirements of NEMA.
 - 2) Conductors shall be stranded copper. The gauge shall be 18 AWG unless specifically stated otherwise in the Drawings for a particular instance.
 - 3) TSP cable shall be designed for noise rejection for process control, computer, or data log application in meeting NEMA WC55 requirements:
 - a) Outer Jacket: 45-mil nominal thickness.
 - b) Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
 - c) Dimension: 0.28-inch nominal OD.
 - d) Conductors:
 1. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 2. 26 AWG, seven-strand tinned copper drain wire.
 3. Insulation: 15-mil nominal PVC.
 4. Jacket: 4-mil nominal nylon.
 5. Color Code: Pair conductors black and white
 - 4) Overall jacket type shall be PVC.

- 5) Conductors shall be twisted and bonded along their length to maintain uniform twists. The number of pairs shall be as identified in the Drawings with a drain wire and overall aluminum foil shield.
- 6) Belden, General Cable, AFC Cable Systems, or approved equal.
- d. Industrial Shielded Category 6 Ethernet Cable (16121.C30).
 - 1) Shall be Ethernet/IP compatible cable.
 - 2) Shielded, rated for 600 volts maximum.
 - 3) Suitable for use as Industrial Ethernet Cable, 100BaseTX.
 - 4) Rated for use in a temperature range between -25 degrees C and 75 degrees C.
 - 5) CMR rated and rated for outdoor use.
 - 6) Shall be 4-pair, solid copper, 23 AWG. Pairs shall be bonded.
 - 7) Cable insulation material shall be Polyolefin
 - 8) Provided with aluminum foil polyester tape shield with 100% insulation coverage.
 - 9) Outer jacket material shall be PVC. Jacket material shall be sunlight and oil resistant. Jacket shall have sequential markings at two foot intervals.
 - 10) Provided with shielded RJ45 connectors, suitable for IP20 applications.
 - 11) Category Ethernet cable shall be Belden Data Tuff Industrial Ethernet 7953A, or approved equal.
- e. VFD Cables (16121.V01).
 - 1) Flexible, shielded VFD cable with three symmetrical ground conductors
 - a) UL 1277, 1000V flexible motor supply cable.
 - b) TC-ER rated, 90 degrees C wet or dry.
 - c) Conductors:
 - 6. 12 AWG thru 10 AWG, tinned copper per ASTM B33, Class K stranding per ASTM B172.
 - 7. 8 AWG thru 2 AWG, tinned copper per ASTM B33, Class H stranding per ASTM B173.
 - 8. Insulation: 45-mil XLPE for conductors 12 AWG thru 10 AWG; 60-mil XLPE for conductors 8 AWG thru 2 AWG.
 - 9. Three full-sized green/solid or striped yellow insulated ground conductors.
 - d) Cable Shield: Overall aluminum shield with minimum 25% overlap with overall tinned copper braid with 85% coverage and full sized tinned copper drain wire(s).
 - e) Jacket: UV-sunlight resistant, flame retardant and chemical resistant.

- f) Provide Belden, Servewire, Southwire, or approved equal.

2.2 ACCESSORIES

- a. Colored Tape (16121.T01).
 - 1) Colored tape shall be used to identify individual conductors larger than # 6 AWG.
 - 2) 3M colored tape, or approved equal.
- b. Cable Ties (16121.T05).
 - 1) Cable ties shall be nylon, adjustable, self-locking, and properly sized for the bundle and force implied.
 - 2) Thomas and Betts, Panduit, or approved equal.
- c. Pulling Compound (16121.P01).
 - 1) Pulling compound shall be non-corrosive, noncombustible, nonflammable waxed based lubricant listed for this use.
 - 2) Ideal Company, Polywater, Inc., or approved equal.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General.
 - 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
 - 2) Conductor and cable installations shall meet or exceed the NECA National Electrical Installation Standards.
 - 3) Twisted Shielded Pair (TSP) cable installation and termination methods are specified in Section 13410 Basic Measurement and Control Instrumentation Materials and Methods and Section 13430 Boxes, Control Panels and Control Centers.
 - 4) CONTRACTOR shall not exceed the manufacturer's recommendations for maximum pulling tensions or minimum bending radii for respective conductors or cables.
 - 5) Pulling compound is recommended for all conductor or cable installations and shall be used on all installations requiring a mechanical pulling device.
 - 6) CONTRACTOR shall furnish and use a dynamometer on all conductor or cable installations requiring the use of a mechanical pulling device. The dynamometer

shall be used to verify the maximum pulling tensions are not exceeded. Should the pulling tensions be exceeded, the conductor or cable shall be removed from the raceway and discarded. It shall not be reused under any circumstance on the project. The CONTRACTOR shall be responsible to make the alterations necessary before attempting to re-pull new conductors or cables.

- 7) Immediately after pulling in conductors or cables, the pulling compound shall be completely removed from the conductors or cables, from boxes, enclosures, floors, walls, etc.
- 8) Conductor and cable installations shall be continuous without splices or intermediate terminations unless specifically identified on the Drawings or prior written approval from the ENGINEER.
- 9) Where conductors or cables are routed in boxes enclosures or cable tray they shall be neatly bundled with cable ties at intervals not to exceed 12 inches on center. The tension for the cable ties shall be set with a tool specifically manufactured for that purpose and of the same manufacturer as the cable tie. Side cutters, linemen pliers and similar tools shall not be used to cut the tail end of the cable tie. The CONTRACTOR shall only use the tool specifically manufactured for this purpose and of the same manufacturer as the cable tie.
- 10) Conductors and cables shall not be installed until the raceway, boxes, enclosures, conduit bushings, etc. have all been installed. Where conductors or cables have been installed prior to meeting this requirement, the ENGINEER shall at their discretion elect to have the conductors or cables removed, disposed of and replaced with new product.
- 11) Should the outer jacket of any conductor or cable be damaged in any way, they shall be removed, disposed of and replaced with new product.
- 12) An equipment grounding conductor shall be installed in all raceways. Size shall be as identified on the Drawings or the NEC, whichever is greater, but in no case shall it be less than # 16 AWG for under 50 volts and no less than # 14 for 50 volts or above.

b. CAT6 Cable Testing

- 1) Patch cable length shall be the shortest possible between termination points. Patch cable installation shall utilize wire management on cabinets and racks.
- 2) Excessively long patch cable installation shall not be coiled up. The CONTRACTOR shall be responsible for providing the correct length of patch cable.
- 3) The permanent link shall be tested.
- 4) All test results shall be used by the CONTRACTOR to determine any polarity and noise anomalies and CONTRACTOR shall take immediate corrective action for all anomalies.

- 5) Test results shall be used by the CONTRACTOR and the Authorized Representative to determine the viability of each sheath for transmission in accordance with the specifications of the cable manufacturer and the requirements imposed by the transmission system. This shall form part of the acceptance procedure for the cable plant. All results obtained by use of pair-scanner testing shall be collated by terminal outlet number and or riser pair number and presented to the Authorized Representative at the conclusion of the testing. Test compilation shall be initialed and dated by the CONTRACTOR's technician performing the test.
- 6) The CONTRACTOR shall utilize a level-III Fluke, PentaScanner, Wavetek or equal, twisted pair test instrument for the testing of all System Category 6 and Category 6A copper cabling. All Category 6 and 6A cable paths shall be tested at each jack for the following parameters and meet the requirements imposed by the TIA/EIA 568-B3 building wiring standard, ANSI/TIA-568-C.4 Broadband Coaxial Cabling and Components Standard, and the manufacturer's written specification.
- 7) All required certification tests shall be performed at 350 MHz.
- 8) Category 6 and data cabling systems shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above and provide for the following tests.
 - a) Wire Map.
 - b) Cable Length.
 - c) Pair-to-Pair NEXT.
 - d) Power Sum NEXT.
 - e) Attenuation.
 - f) Pair-to-Pair ELFEXT.
 - g) Power Sum ELFEXT.
 - h) Return Loss.
 - i) Propagation Delay.
 - j) Delay Skew.
- 9) A complete cable certification report shall be provided covering all locations.
- 10) The CONTRACTOR shall compile test results into the forms that contain all applicable test data. Hard copy indicating successful testing for every location is required by the OWNER. A flash drive or disc containing the test data and appropriate application (software) to display such in a windows-based environment shall also be provided. All forms shall be neatly completed and legible when submitted. Hard copy optical traces shall be neatly and securely attached to the test results.
- 11) A copy of the test results shall be maintained by the CONTRACTOR for one (1) year from the time of acceptance by the OWNER.

END OF SECTION

SECTION 16128
ELECTRIC PIPE TRACING

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) This Section includes the requirements for self-regulating electric pipe heat tracing systems.
 - 2) Heating cable, power connection kits, end seals, attachment tape, warning labels, and accessories required for a complete operating system.
 - 3) Ground-fault protective device or integral power connection assembly as required by code, product listing, and manufacturer's written instructions.
 - 4) Alarm contact closure for general alarm status and wiring interfaces.
 - 5) Field testing, startup, and coordination with insulation installation.

1.2 REFERENCES

- a. The following is a list of Standards which may be references in the Section.
 - 1) CSA Group (CSA).
 - a) C22.2 No. 130 – Requirements for Electrical Resistance Trace Heating and Heating Device Sets.
 - 2) Institute of Electrical and Electronics Engineers (IEEE).
 - a) 515 – Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Industrial Applications.
 - b) 515.1 – Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications.
 - 3) National Electrical Manufacturers Association (NEMA).
 - a) 250 – Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - 4) National Fire Protection Association (NFPA).
 - a) 70 – National Electrical Code.
 - 5) Underwriters Laboratories, Inc. (UL).
 - a) 515 – Electrical Resistance Trace Heating for Commercial and Industrial Applications.

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.

b. Submittal Format:

- 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
- 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
- 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
- 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.

d. Product Data

- 1) Pursuant to Section 01300 – Submittal Procedures.
- 2) Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

1.4 QUALITY ASSURANCE

- a. Manufacturer shall be regularly engaged in the manufacture of electric heat tracing systems of the type specified.
- b. Installer shall be experienced with electric heat tracing installation and shall follow the manufacturer's written instructions.
- c. Provide one complete heat tracing system by a single manufacturer; do not mix cable, power connection components, and accessories from multiple manufacturers.

1.5 WARRANTY

- a. Provide manufacturer's standard warranty, but not less than one year from Date of Substantial Completion, for heating cable and accessory components.

- b. Repair or replace defective materials and workmanship at no additional cost to OWNER.

PART 2: PRODUCTS

2.1 MATERIAL

a. Heat Trace & Controller (16128.H01).

- 1) Provide heat trace & controller as shown on the Drawings.
 - a) The heat trace shall be wrapped around the pipe with a density of winds per foot as directed by the Manufacturer.
 - b) The overall horizontal and vertical length of the pipe requiring heat trace has been noted on the Drawings.
 - c) The final length, which is based on the winds per foot and the diameter of the pipe shall be determined by the CONTRACTOR.
- 2) Heating cable:
 - a) Type: Self-regulating electric resistance heating cable for pipe freeze protection.
 - b) Nominal output: 5 watts per foot for the basis-of-design application, unless revised by the manufacturer for the verified actual field conditions and accepted by Engineer.
 - c) Cable shall be suitable for the pipe material on which it is installed. Contractor shall verify actual pipe material before ordering cable.
 - d) Cable outer jacket and system accessories shall be suitable for the installed environment, including outdoor exposure and wet locations where applicable.
 - e) Heating cable shall be capable of being cut to length in the field in accordance with manufacturer's written instructions.
- 3) Power Connection Kits & End Seals
 - a) Provide manufacturer's standard power connection kit listed for the specific cable furnished and the actual installation environment.
 - b) Basis-of-design power connection kit: ECW-DW.
 - c) Provide manufacturer's compatible end seal at each cable end.
 - d) Power connection assembly shall include, or be provided in conjunction with, required ground-fault protective function and alarm contact closure required by this Section.
- 4) Controls and Alarms Interface
 - a) Provide control and monitoring components required for a complete operating system, whether integral to the power connection kit or furnished as separate matched accessories by the heat tracing manufacturer.
 - b) Provide at minimum one isolated contact closure for transmission of a general alarm to the OWNER's SCADA / BAS system.
 - (1) Alarm contact shall remain available after installation for wiring and commissioning.
 - c) Where separate control modules are required by the manufacturer for the actual installation, furnish them as part of this Section.

- 5) Accessories
 - a) Provide manufacturer's adhesive attachment tape for securing heating cable to piping. Generic tape substitutions are not acceptable unless specifically recommended by the heating cable manufacturer.
 - b) Provide manufacturer-recommended labels, caution markings, and accessory items required for a complete installation.
 - c) Provide weatherproof junction boxes, fittings, supports, and similar items as required for a complete and code-compliant installation.
- 6) Provide Raychem with ECW-DW controller, or approved equal.

2.2 SOURCE QUALITY CONTROL

- a. Furnish new materials only.
- b. Inspect cable and accessory packaging before installation.
- c. Do not use products showing evidence of damage, moisture intrusion, or improper storage.

PART 3: EXECUTION

3.1 INSTALLATION

- a. All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
- b. Install heat tracing only at locations indicated on the Drawings, including the condensate piping shown on the enlarged electrical roof plan.
- c. Install heating cable, power connection kit, end seal, and accessories in strict accordance with manufacturer's written instructions and product listing.
- d. Attach heating cable to pipe using the manufacturer's adhesive tape and installation spacing recommended for the furnished cable system.
- e. Do not use unapproved tapes, tie wire, metal bands, or other fastening methods in direct contact with cable unless specifically allowed by the manufacturer.
- f. Coordinate all penetrations, supports, terminations, and insulation interfaces to avoid cable damage and to maintain a complete and continuous heat tracing installation.
- g. Install power connection kits and end seals in accessible locations to permit inspection, testing, and maintenance.
- h. Provide branch-circuit wiring, grounding, and raceway in accordance with Division 16 requirements and the manufacturer's written instructions.
- i. Wire the heat tracing system alarm contact closure to BAS for general alarm indication.

- j. Do not energize heating cable while on reel or while improperly coiled unless specifically permitted by the manufacturer.

3.2 FIELD QUALITY CONTROL

- a. Perform continuity and insulation resistance tests in accordance with the manufacturer's written instructions.
- b. At a minimum, test heating cable after installation on pipe and prior to insulation, and retest after insulation installation and prior to energizing.
- c. Test operation of ground-fault protective device.
- d. Test general alarm contact closure and verify alarm point operation.
- e. Submit written test results.

3.3 STARTUP AND ADJUSTING

- a. After successful testing, energize system and verify proper operation.
- b. Confirm heat tracing does not nuisance trip under normal operating conditions.
- c. Adjust control settings, if adjustable components are furnished, in accordance with manufacturer's recommendations for the actual installation.

3.4 3.06 CLOSEOUT

- a. Provide as-installed record identifying traced piping, branch circuit source, cable type, alarm interface location, and tested results.
- b. Provide O&M information in accordance with Section 16010.
- c. Provide demonstration and training in accordance with Section 16015.

END OF SECTION

SECTION 16131 CONDUIT AND FITTINGS

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes
 - 1) The Section includes the requirements pertaining to conduits and fittings used to contain electrical conductors and cables.
 - 2) All conductors and cables shall be installed in conduit or approved raceways regardless of which Division the conductors or cables are specified.

1.2 REFERENCES

- a. The following is a list of standards which may be referenced in this Section.
 - 1) American National Standards Institute (ANSI).
 - a) C80.1, Rigid Steel Conduit-Zinc Coated.
 - 2) American Society for Testing Materials (ASTM).
 - a) A123 E1, Standard Specification for Zinc-Coated (Galvanized) Coatings on Iron and Steel Products.
 - 3) National Electrical Contractors Association (NECA).
 - a) National Electrical Installation Standards (NEIS).
 - 4) National Electrical Manufacturers Association (NEMA).
 - a) RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Coated and Intermediate Metal Conduit.
 - b) TC 3, PVC Fittings for use with Rigid PVC Conduit and Tubing.
 - c) TC 6, PVC and ABS plastic Utilities Duct for Underground Installation.
 - 5) Nation Fire Protection Association (NFPA).
 - a) 70, National Electrical Code (NEC).
 - 6) Underwriters Laboratories, Inc. (UL).
 - a) 6, Standard for Safety Rigid Metal Conduit.
 - b) 514B, Standards for Safety Fittings for Conduit and Outlet Boxes.
 - c) 651, Standard for Safety Schedule 40 and 80 PVC Conduit.
 - d) 651A, Standard for Safety Type EB and Rigid PVC Conduit and HDPE Conduit.
 - e) 1660, Standard for Safety Liquid-Tight Flexible Nonmetallic Conduit.
 - f) 360, Standard for Safety Liquid-Tight Flexible Metallic Conduit.
 - g) 797, Standard for Safety Electrical Metallic Conduit.

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.
 - 2) Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

1.4 QUALITY ASSURANCE

- a. PVC Coated Galvanized Rigid Steel Conduit Installation Training and Certification.
 - 1) All installers of PVC Coated Galvanized Rigid Steel Conduit shall be factory trained and certified prior to the installation of any PVC Coated Galvanized Rigid Steel Conduit. CONTRACTOR shall provide written proof of current factory certification for all installers.
- b. All PVC Coated Galvanized Rigid Steel Conduit shall be warranted for three (3) years, minimum.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Galvanized Rigid Steel Conduit (GRC) (16131.C01).
 - 1) Shall be mild steel, hot dipped galvanized inside and out.
 - 2) Shall be manufactured in accordance with ANSI C80.1 – Rigid Steel Conduit, Zinc Coated, and UL-6.
 - 3) Conduit fittings shall be hot dipped galvanized malleable iron.
 - 4) Condulets shall form 7 type.
 - 5) The use of three-piece couplings shall be incorporated only when unavoidable and not simply due to poor planning and layout.
 - 6) The use of compression, setscrew and split conduit fittings is unacceptable.
 - 7) Gaskets shall be installed on all condulet covers regardless of the environment they are installed in.
 - 8) Conduit straps shall be hot dipped galvanized malleable iron and incorporate matching conduit spacers when attached directly to walls, ceilings and floors.
 - 9) LTV steel, Triangle PWC, or approved equal.
- b. PVC Coated Galvanized Rigid Steel Conduit (PVC-GRC) (16131.C10).
 - 1) Shall meet the manufacturing specification of GRC before PVC coating is applied.
 - 2) Shall be manufactured in accordance with NEMA RN1 Standard for PVC coated GRC.
 - 3) Exterior PVC coating shall not be less than 40 mils thick.
 - 4) The exterior coating shall be sufficiently flexible to permit field bending the conduit without cracking or flaking the coating.
 - 5) Chemically cured two-part urethane coating, at a nominal 2 mil thickness shall be applied to the interior of all conduit and fittings.
 - 6) Female conduit or fitting opening shall have a PVC sleeve extending one-conduit diameter or 2 inches; whichever is less, beyond the opening.
 - 7) The inside diameter of the sleeve shall be the same diameter as the outside diameter of the conduit before the coating is applied.
 - 8) The wall thickness of the sleeve shall be 40 mil minimum.

- 9) Conduit fittings, condulets, mounting hardware and accessories shall be PVC coated to the same specifications as the conduit.
 - 10) Condulets shall be form 7 type.
 - 11) Gaskets shall be installed on all condulet covers regardless of the environment they are installed in.
 - 12) The screw heads on condulets shall be encapsulated by the manufacturer with a corrosion resistant material, or shall be stainless steel. All condulets shall have the same type of type of screw heads, stainless steel or encapsulated.
 - 13) The use of three-piece couplings shall be incorporated only when unavoidable and not simply due to poor planning and layout.
 - 14) The use of compression, setscrew and split conduit fittings is unacceptable.
 - 15) Ocal Inc., Perma-coat, or approved equal.
- c. Liquid-Tight Flexible Aluminum Conduit (LFAC) (16131.C20).
- 1) Shall be constructed of a flexible aluminum core with a sunlight resistant thermoplastic outer jacket.
 - 2) Conduit fittings shall be manufactured to the PVC-GRC fitting specifications. Galvanized or non-metallic conduit fittings are unacceptable unless written approval is obtained from the ENGINEER for specific locations before installation.
 - 3) No couplings shall be installed.
 - 4) Sealing rings shall be installed where conduit terminates at an enclosure.
 - 5) Conduit shall be Anaconda, Electriflex, T & B, or approved equal.
 - 6) Sealing ring shall be OZ Gedney 4Q-G, or approved equal.
- d. Rigid Non-metallic Conduit (PVC 40) (16131.C30).
- 1) Shall be schedule 40 PVC unless specifically called out otherwise on the Drawings.
 - 2) Shall be sunlight resistant.
 - 3) Shall be manufactured in accordance with UL-651 Standard.
 - 4) Conduit and fittings shall be securely glued.
 - 5) Provide conduit bell ends at vaults unless specifically called out otherwise on the Drawings.

- 6) Provide PW Pipe, Carlon, or approved equal.
- e. Rigid Non-metallic Conduit (PVC 80) (16131.C35).
 - 1) Shall be schedule 80 PVC unless specifically called out otherwise on the Drawings.
 - 2) Shall be sunlight resistant.
 - 3) Shall be manufactured in accordance with UL-651 Standard.
 - 4) Conduit and fittings shall be securely glued.
 - 5) Provide conduit bell ends at vaults unless specifically called out otherwise on the Drawings.
 - 6) Provide PW Pipe, Carlon, or approved equal.
- f. Hazardous Location Flexible Coupling (16131.C40).
 - 1) Shall be listed for Class 1, Division Hazardous Locations.
 - 2) Shall be constructed of flexible brass tubing, insulating wire duct, bronze outer braid, bronze end fittings, and protective PVC coating.
 - 3) Shall be liquid-tight.
 - 4) Shall be Crouse Hinds EC Series, or approved equal.

2.2 ACCESSORIES

- a. Conduit Thread Lubricant (16131.L01).
 - 1) Shall be an electrically conductive with copper particles suspended in the product.
 - 2) Provide Kopr-Shield Catalog number CP8-TB, or approved equal.
- b. Glue (16131.G01).
 - 1) Glue shall be the wet/dry rated cement commonly referred to as “Blue Glue”.
- c. Conduit Duct Spacers (16131.S01).
 - 1) Shall be used in conduit duct banks to maintain uniform spacing of conduits.
 - 2) Shall be non-metallic, interlocking type manufactured for this purpose. Shall be sized to maintain a minimum of 3 inches of separation between conduits.
 - 3) Provide Underground Devices Wunpeece, IPEX Monoblock, or approved equal.

- d. Modular Floor and Wall Sleeves (16131.S10).
 - 1) Seals shall be rated at 20 PSIG minimum.
 - 2) Shall have stainless steel hardware.
 - 3) Shall be properly sized for the conduit.
 - 4) Provide modular sealing system resistant to acids and alkalis. Temperature range of – 40 to 210 degrees F.
 - 5) Provide link-seal Model number S-316, or approved equal.
- e. Cord Grip (CGB) (16131.C89).
 - 1) Provide stainless steel bodied cord grips with NPT mounted in conduit couplings as identified on the Drawings.
 - 2) Provide Hubbell, Kellems, or approved equal.
- f. Pulling Twine (16131.T31).
 - 1) Provide 200 pound tensile strength pulling twine in spare conduits and as called out elsewhere on the Drawings.
 - 2) Greenlee twine, or approved equal.
- g. Cord Connector (16131.C90).
 - 1) Provide stainless steel cord grip with integrated stainless steel mesh.
 - 2) Provide Hubbell SCH1000 Series, or approved equal.
 - 3) Provide cord grip with stainless steel integrated mesh for any unsupported cord longer than 59 inches to provide adequate support of the cord.
- h. Conduit Measuring Tape (16131.M01).
 - 1) Shall be made of Kevlar.
 - 2) Shall have printed measurements no less than every foot.
 - 3) Shall have average breaking strength of at least 1,250 pounds.
 - 4) Provide Greenlee product, or approved equal.
- i. Conduit Measuring Tape (Polyaramid) (16131.M02).
 - 1) Provide tape in spare conduits and as called out elsewhere on the Drawings.
 - 2) Shall be made of Polyaramid material.

- 3) Shall have printed measurements no less than every foot.
 - 4) Shall have breaking strength of 1,250 pounds.
 - 5) Greenlee Catalog number 39243, or approved equal.
- j. Bushing Plug (16131.P90).
- 1) Provide OZ Gedney type PPC bushing plug, or approved equal.
- k. Conduit System Drain (16131.D33).
- 1) Provide a conduit system drain designed specifically for the purpose of draining accumulated condensate and to provide ventilation designed to minimize condensation.
 - 2) The device shall UL Standard 514B certified.
 - 3) The bodies and locknut shall be copper-free aluminum construction. The device shall be supplied with a stainless steel screen which may be removed and cleaned as required.
 - 4) Provide a Cooper Crouse-Hinds 0.75 inch drain catalog number CD2-SA, or approved equal.
- l. Threaded Hubs (16131.H01).
- 1) Hubs for threaded attachment of steel conduit to sheet metal enclosures:
 - 2) Construction:
 - a) Insulated throat.
 - b) PVC coated when used in corrosive areas.
 - c) Bonding locknut.
 - d) Recessed neoprene O-ring to assure watertight and dust- tight connector.
 - e) One half (1/2)-inch through 6-inch steel zinc electroplated.
 - f) Aluminum with aluminum conduit.
 - 3) Usage:
 - a) All conduits shall use threaded hubs for connections to metal enclosures.
 - 4) Provide Crouse-Hinds Myers Hub, or approved equal.
- m. Sealing Fittings (16131.S02).
- 1) Construction:
 - a) 40 percent wire fill capacity.
 - b) Shall be rated for horizontal and vertical installations.
 - c) PVC-coated when used in corrosive areas.
 - d) Malleable ductile iron with steel conduit.
 - e) Aluminum with aluminum conduit.
 - f) Crouse-Hinds Type EYD where drains are required.

- g) Crouse-Hinds Type EYS where drains are not required.
 - h) UL listed for use in Class I, Division 1, Groups A, B, C, D; Class I, Division 2, Groups A, B, C, D; Class II, Divisions 1 and 2; Groups E, F, and G.
- 2) Sealing compound:
 - a) Fiber filler and cement as recommended by the sealing fitting manufacturer.
 - b) Approved for the conditions and use.
 - 1. Not affected by surrounding atmosphere or liquids.
 - 3) Melting point shall be 200 degrees Fahrenheit minimum.
 - 4) Provide Crouse-Hinds, or approved equal.
- n. Duct Seal (16131.D44).
- 1) Seal all conduits passing from the interior to the exterior of a building or structure with flexible/removable duct seal.
 - 2) Provide Hubbell-Raco DS-XLB Duct Seal Weather Sealing, or approved equal.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General Requirements
- 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification
 - 2) Install conduit runs in accordance with the schematic representation shown on the Drawings.
 - 3) Refer to the Plant Area Work Requirements Table in section 16050 which specifies the permitted uses for conduit types.
 - 4) Minimum conduit size shall be 0.75 INCH unless specifically called out otherwise on the drawings.
 - 5) Where raceways are indicated, but the routing is not identified, the routing shall be the CONTRACTOR'S choice and in accordance with the rest of the Contract Documents and the National Electrical Code (NEC).
 - a) Install conduit runs as specified with schematic representation indicated on the Drawings and as specified.
 - b) Modify conduit runs to suit field conditions, as accepted by the Engineer:
 - 2. Make changes in conduit locations that are consistent with the design intent but are dimensionally different, or routing to bypass obstructions.
 - 3. Make changes in conduit routing due to the relocation of equipment.

- c) The Electrical Drawings do not indicate all required junction boxes and pull boxes:
 - 4. Provide junction boxes and pull boxes to facilitate wire pulling as required:
 - i. To meet cable manufacturer's pulling tension requirements.
 - ii. To limit total conduit bends between pull locations.
 - 5. Install junction boxes and pull boxes at locations acceptable to the Engineer.
 - d) The Contractor is responsible for any deviations in general location, conduit size, routing, or changes to the circuit/raceway block diagrams without the express written approval or direction by the Engineer:
 - 6. The Engineer is the sole source in determining whether the change is constituted as a deviation:
 - 7. Perform any changes resulting in additional conduits, or extra work from such deviations.
 - 8. Incorporate any deviations on the Record Documents.
 - e) Owner reserves the right to deduct the amount of applicable reimbursement, equivalent to the cost of the engineering effort required to show those unauthorized changes on Record Drawings.
- 6) Raceways shall be electrically and mechanically complete before the conductors are installed.
 - 7) Routing of conduits may be adjusted to avoid obstructions. Coordinate with other trades prior to installation of raceways. Lack of such coordination shall not be justification for extra compensation and removal and reinstallation to resolve conflicts shall be at the CONTRACTOR's expense.
 - 8) Conduit joints shall be wrench tight, thoroughly grounded, secure and free of obstructions.
 - 9) Conduits shall be reamed.
 - 10) Metallic threads shall all be coated with conduit thread lubricant before assembly. Failure to install the lubricant will result in removal of all conduit and reassembly with the conduit lubricant.
 - 11) Exposed conduits shall be installed parallel or perpendicular to the structural members and surfaces and shall be level and or plumb.
 - 12) When two or more conduits are routed in the same general direction their routing shall be parallel with symmetrical bends.
 - 13) Conduits shall be bent with equipment specifically designed for this purpose and for the specific size and type of conduit.
 - 14) Conduits that are creased or crushed shall be replaced.

- 15) Install conduits such that they do not interfere with the proper and safe operation of equipment and do not block or otherwise interfere with the ingress and egress and installation of removable hatches and covers.
- 16) Install expansion joints as needed across expansion joints in the structure and at other locations where necessary to compensate for thermal or mechanical expansion or contraction.
- 17) Conduits shall be routed at least six (6) inches from high temperature piping, ducts and flues.
- 18) Conduits installed in exposed areas indoors shall be GRC type unless the area contains potentially corrosive elements.
- 19) Conduits that terminate at an enclosure that does not have a threaded hub shall be installed with a Myers type hub and ground ring. No exceptions shall be permitted without prior written approval for specific locations issued by the ENGINEER. Conduits that are permitted to terminate without a Myers type hub or a threaded hub shall have a ground bushing installed. A separate bonding conductor shall be routed to all ground bushings within an enclosure and be bonded to the enclosure and grounding conductor if present.
- 20) Final connections to dry type transformers, motors, instruments and other equipment requiring a flexible connection shall be made with LFAC conduit. Lengths shall not exceed three (3) feet.
- 21) All conduits shall be capped throughout construction to prevent entrance of dirt, trash, water, etc.
- 22) All conduits that are trade size 2.5" and larger which are routed through floors, ceilings or walls below grade shall include a large enough opening to accommodate the installation of Link-Seal. After installation and inspection of the Link-Seal, the CONTRACTOR shall install non-shrink type grout that matches the color of the surrounding material. The grout shall be installed on both sides of the Link-Seal installation.
- 23) Support conduit runs on water-bearing walls a minimum of 7/8- inch away from wall on an accepted preformed channel:
 - a) Do not run conduit within water-bearing walls unless otherwise indicated on the Drawings.
- 24) When installing conduit through existing slabs or walls make provisions for locating any possible conflicting items where conduit is to penetrate. Use tone signal or X-ray methods to make certain that no penetrations will be made into existing conduit, piping, cables, post-tensioning cables, etc.
- 25) All power conduits routed to or from an adjustable frequency drive or a variable frequency drive shall be metallic conduit. Conduits installed underground shall meet the requirements listed below under part B; underground and concrete encased conduit installation.

- 26) Spare conduits shall be provided with a coupling and threaded male plug that matches the makeup of the conduit for the area they are installed in. The conduit shall terminate at an enclosure when one is called out and exists as part of the Work. Where the spare conduit is stubbed up in a concrete slab for future equipment, it shall be installed flush with the finished floor. Where spare conduits are routed to other areas such as outside a building envelope, in an attic, to a vault, etc., the conduit shall have a female conduit cap installed.
- 27) All conduits shall be individually identified at every point they terminate. The conduit identification shall be the same as that which is used on the conduit /conductor schedule in the Drawings. Should conduits be installed that are not listed on the conduit schedules, the CONTRACTOR shall add conduit callouts to the as-built conduit schedules and label the conduits accordingly.
- 28) For innerduct installations, provide liquid tight connectors where appropriate. No splicing of the innerduct is allowed.

b. PVC-GRC Conduit Installation

- 1) Strap wrenches and vises shall be used to install PVC-GRC conduit to prevent wrench marks and damage to the outer PVC coating. Conduits with damaged coating shall be replaced, repair is unacceptable.
- 2) Conduits installed in all outdoor locations, corrosive areas and vaults shall be PVC-GRC. PVC-GRC conduit with damaged PVC coating shall be replaced. Repair is unacceptable.

c. Hazardous Locations

- 1) Within all Class 1, Division 1 Hazardous Locations, provide conduit seal offs and boxes and fittings listed for Class 1, Division 1 Hazardous Locations per the NEC.
- 2) Flexible connections to motors within a Hazardous Location shall be made with a Hazardous Location Flexible Coupling. Lengths shall not exceed three (3) feet.

d. Conduit Sealing and Drainage

- 1) Provide conduit drains installed as shown on the Drawing details and in conduit systems as identified on the Drawings. Discuss the installation details with the ENGINEER before underground conduits are covered. Changes that may become necessary in the conduit system resulting from a lack of coordination with the ENGINEER prior to covering underground conduits shall be completed by the CONTRACTOR at no additional expense to the OWNER.
- 2) Conduit drainage and sealing other than required for hazardous and classified areas:
 - a) Provide sealing and drainage in vertical drops of long (in excess of 20 feet), exterior, above grade conduit runs at the points at which the

- conduit enters buildings, switchgear, control panels, lighting panelboards, and other similar enclosures.
- b) Provide seal fittings with drains in vertical drops directly above grade for exterior, above grade conduit runs that are extended below grade.
 - c) Provide conduit seals with drains in areas of high humidity and rapidly changing temperatures:
 - 9. Where portions of an interior raceway pass through walls, ceilings or floors that separate adjacent areas having widely different temperatures.
 - d) Provide conduit seals similar to O/Z Gedney (Type CSM) on all conduits between corrosive and non-corrosive areas.
 - e) Seal one end only of all underground conduits at highest point with O/Z Gedney sealing (non-hazardous) filling, or equal.
- 3) Install seals with drains at any location along conduit runs where moisture may condense or accumulate. This requirement includes, but is not limited to, the following locations: control panels, junction boxes, pullboxes, or low points of conduit.
- 4) All conduits which enter/leave a building shall be sloped away from the building to prevent the accumulation of water within the building.
- 5) All conduits which enter/leave a building shall be sealed with an approved duct seal.
- e. Underground Conduit Installation
- 1) Underground conduits shall be PVC except as specifically noted differently elsewhere.
 - 2) All power conduits routed to or from an adjustable frequency drive or a variable frequency drive shall be metallic conduit. Where routed underground these conduits shall be PVC-GRC type conduit.
 - 3) Underground conduits shall be routed as shown on the Drawings.
 - 4) Power conduits shall be separated from all other conduits by a minimum of 12 inches and when required to cross other conduits it shall be done at a 90 degree angles.
 - 5) Conduit bends greater than 45 degrees shall utilize PVC-GRC conduit for the bend.
 - 6) Conduit runs stubbed out of concrete shall make a transition to PVC-GRC at least six (6) inches before leaving the encasement.
 - 7) Conduits routed in structural concrete shall be routed in such a manner as to not interfere with the structural integrity of the concrete. The ENGINEER shall approve CONTRACTOR's proposed conduit routing before installation. It is the CONTRACTOR's responsibility to coordinate conduit routing with the

ENGINEER well before it is scheduled to be installed. Conduits shall be stubbed up directly under the enclosure or device they will serve. The CONTRACTOR is responsible to coordinate with the other trades prior to installation of raceways. Lack of coordination shall not be justification for extra compensation and removal and re-installation of conduits to resolve conflicts shall be done at the CONTRACTOR's expense.

- 8) Underground conduit shall have a minimum of 24 inches of cover unless specifically called out differently on the Drawings.
- 9) Conduits for the local Utilities shall be of the conduit type they specify, which may or may not include HDPE or fiberglass.
- 10) Conduits routed from or to buildings or structures shall be concrete encased unless specifically called out differently on the Drawings.
- 11) Underground conduits stubbing up out of concrete:
 - a) Conduits routed under a concrete slab shall be routed under the vapor barrier.
 - b) The conduits shall be routed deep enough so the radius of the conduit stubbed up through the slab is completely below grade.
 - c) The vapor barrier shall be sealed at every point a conduit penetrates the barrier as per the requirements specified for the vapor barrier.
 - d) All conduit and elbows stubbing up through concrete shall extend a minimum of two (2) inches above finished floor or grade, including housekeeping pads, before transitioning to any other conduit type, unless noted otherwise on the Drawings.
 - e) PVC-GRC versus PVC-Tape Wrapped GRC Elbows:
 - (1) Conduits stubbing up through concrete floors or slabs inside enclosed buildings such as the Blower Building, DAF Building, or Storage Building may use GRC conduit wrapped with PVC tape.
 - (2) All other locations shall use PVC-GRC conduit elbows, without exception.
 - f) Refer to the conduit elbow details referenced in the Drawings.

f. Miscellaneous

- 1) Provide cord grip for any unsupported cord.

END OF SECTION

SECTION 16135
BOXES AND ENCLOSURES

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) This Section includes requirements for electrical device boxes, enclosures, in-ground boxes and vaults.

1.2 REFERENCES

- a. The following is a list of Standards that may be referenced in the Section.
 - 1) American Society for Testing and Materials (ASTM).
 - a) A123 E1 Standard Specifications for Zinc-Coated Coatings on Iron and Steel Products.
 - 2) National Electrical Contractors Association, Inc. (NECA).
 - a) 5055 National Electrical Installation Standard.
 - 3) National Fire Protection Association (NFPA).
 - a) 70 National Electrical Code (NEC)
 - 4) Underwriters Laboratory, Inc. (UL).
 - a) 514C Standard for Safety Non-Metallic Outlet Boxes, Flush Device Boxes and Covers.
 - b) 50 Enclosures for Electrical Equipment.

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

- 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
- 1) Pursuant to Section 01300 – Submittal Procedures.
 - 2) Manufacturer’s data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2: PRODUCTS

2.1 DEVICE BOXES

- a. Cast Iron Boxes (16135.B01).
- 1) Shall be cast iron galvanized boxes, have tapered threaded hubs and be the deep FD type in all cases.
 - 2) Boxes shall have internal grounding screw.
 - 3) Shall have external mounting tabs.
 - 4) Whichever manufacturer is submitted and approved, all like boxes on Project shall be of the same manufacturer.
 - 5) Provide OZ Gedney, Crouse-Hinds, or approved equal.
- b. PVC Coated Cast Iron Boxes (16135.B10).
- 1) Shall comply with the specification for cast iron boxes.
 - 2) Shall be coated to the same specifications as the PVC-GRC conduit.
 - 3) Shall have external mounting tabs.
 - 4) Whichever manufacturer is submitted and approved, all like boxes on Project shall be of the same manufacturer.

- 5) Provide Ocal, Perma-Coat, or approved equal.
- c. Galvanized Sheet Metal Boxes (16135.B15).
 - 1) Shall comply with NEMA specifications for sheet metal boxes.
 - 2) Shall not exceed 4-11/16 inches square.
- d. General Enclosures (NEMA 12) (16135.E12).
 - 1) Shall be NEMA 12, gasketed, painted steel.
 - 2) Shall have an aluminum interior mounting panel (backpanel).
 - 3) Shall be constructed of stainless steel with hinged and gasketed door.
 - 4) Provide with necessary accessories and those shown on the Drawings.
 - 5) Provide a grounding kit.
 - 6) Whichever manufacturer is submitted and approved, all like boxes on Project shall be of the same manufacturer.
- e. General Enclosures (NEMA 4X) (16135.E40).
 - 1) Shall be NEMA 4X, 316 stainless steel.
 - 2) Shall have an aluminum interior mounting panel (backpanel).
 - 3) Shall be constructed of stainless steel with hinged and gasketed door.
 - 4) Provide with necessary accessories and those shown on the Drawings.
 - 5) Provide a grounding kit.
 - 6) Whichever manufacturer is submitted and approved, all like boxes on Project shall be of the same manufacturer.
- f. Instrumentation Enclosures (16135.E90).
 - 1) Enclosures shall be NEMA 4X, type stainless steel.
 - 2) The enclosure bodies shall be 14 gauge and the covers and doors shall be 16 gauge minimum.
 - 3) Seams shall be continuous welded and ground smooth.
 - 4) Fastening holes in back of body for direct mounting or optional external mounting brackets where required.
 - 5) Ground bonding provisions on the cover or door and ground stud in body.

- 6) Seamless foam-in-place gasket for door.
- 7) 3/16 inch clear polycarbonate window mounted flush with cover surface.
- 8) 180 degree door opening.
- 9) Removable type 316 stainless steel hinge pins.
- 10) Provide Hoffman Inline window door enclosure catalog Hoffman In-Line Series, or approved equal.
- 11) Provide Hoffman conductive panel (backpanel), or approved equal.
- 12) Provide Hoffman grounding kit #LLGK, or approved equal.
- 13) Provide Hoffman keyed, lockable wing knob latch #LLKWK, or approved equal. All enclosures on Project shall be keyed alike.

g. Medium In-Ground H15 Concrete Polymer Box (16131.M20).

- 1) Shall be polymer concrete in ground box with flush polymer cover.
- 2) Lid Dimensions shall be 17" x 30" x 24" deep.
- 3) Lid shall be rated for Medium Duty, Tier 15 loading.
- 4) Bolts shall be provided with tamper resistant bolts for cover.
- 5) Cover shall have verbiage molded into the top identifying the type of service served such as electric, fiber optic, communications, etc.
- 6) Provide Old Castle Polymer 1730 series, or approved equal.

h. In-Ground Pulling Vault (16131.V10).

- 1) Concrete construction.
- 2) Shall be 24" x 36" (interior), 32" x 44" (exterior).
- 3) Height shall be 32" (interior), 42" exterior.
- 4) Cover all be square with square galvanized steel diamond plate door with locking latch.
 - a) Door shall open 180-degrees.
- 5) Vault shall be H-20 rated.
- 6) Lid and hatch shall be H-20 rated.
- 7) Provide Old Castle 233-LA or approved equal

PART 3: EXECUTION

3.1 INSTALLATION

a. General.

- 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
- 2) Install boxes and enclosures in accordance with the schematic representation as indicated on the Drawings.
- 3) Boxes and enclosures shall be mounted level and plumb.
- 4) Boxes and enclosures shall not be altered, holes drilled, etc. in any way that may compromise the NEMA rating of the enclosure or box.
- 5) Boxes and enclosures shall be mounted with stainless steel hardware.
- 6) Boxes and enclosures shall be bonded to the equipment grounding conductor.
- 7) Surface mounted enclosures and boxes shall be spaced off the surface at least ¼ inch in damp or wet locations.
- 8) Boxes and enclosures with threaded hubs or punched holes shall have the opening match the conduit size. The use of reducing bushings or reducing washers is unacceptable.
- 9) Galvanized cast iron boxes are permitted only where GRC conduit is permitted.
- 10) PVC-coated boxes shall be used wherever PVC-GRC conduit is required.
- 11) Enclosures shall be provided whenever a junction or pull box larger than 4 inches square is required.
- 12) Sheet metal boxes are permitted only in locations where EMT conduit is approved.
- 13) Provide a divider whenever a box contains conductors of different potentials that the code requires separation.
- 14) Install vaults and in-ground box tops (lids) such that they are ½ inch above finished grade to prevent water ingress.

END OF SECTION

SECTION 16140 WIRING DEVICES

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) This Section includes the requirements for wiring devices such as receptacles, toggle switches and devices plates.

1.2 REFERENCES

- a. The following is a list of Standards which may be references in the Section.
 - 1) National Electrical Contractors Association (NECA): National Electrical Installation Standards (NEIS).
 - 2) National Electrical Manufacturers Association (NEMA).
 - a) WD1 – General Requirements for Wiring Devices.
 - b) WD6 – Wiring Device Dimensional Requirements.
 - 3) National Fire Protection Association (NFPA): 70.
 - 4) Underwriters Laboratories, Inc. (UL): 1070.

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

- 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.
 - 2) Manufacturer’s data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2: PRODUCTS

2.1 MATERIALS

- a. General Purpose Receptacles (16140.R01).
 - 1) Shall be extra heavy duty, industrial grade, tamper/weather resistant.
 - 2) Shall be two-pole, three wire grounding type with screw type terminals suitable for number 10 American Wire Gauge (AWG).
 - 3) Shall be NEMA 5-20R, rated for 20 amperes, 125 volt configuration.
 - 4) Provide duplex or single receptacles as shown on the Drawings.
 - 5) Shall be gray in color unless fed from an emergency circuit and in that case the receptacle shall be red in color.
 - 6) Provide Leviton 5362, industrial extra heavy duty grade receptacles, or approved equal.
- b. Ground Fault Circuit Interrupter Receptacles (16140.R10).
 - 1) Shall be extra heavy duty industrial grade, tamper/weather resistant with integral GFCI protection, test and reset switches.
 - 2) Shall be two-pole, three wire grounding type with screw type terminals suitable for number 10 American Wire Gauge (AWG).
 - 3) Shall be NEMA 5-20R, rated for 20 amperes, 125 volt configuration.
 - 4) Provide duplex or single receptacles as shown on the Drawings.
 - 5) Shall be gray in color unless fed from an emergency circuit and in that case the receptacle shall be red in color.

- 6) Provide Hubbell G5362 industrial extra heavy duty grade GFCI receptacles, or approved equal.
- c. General Purpose Toggle Switches (16140.S01).
- 1) Shall be extra heavy duty industrial grade with grounding screw, 20 amperes, 120-277 volt rated with screw type terminals suitable for number 10 American Wire Gauge (AWG).
 - 2) Single or double throw, single pole, three-way or four-way as shown on the Drawings.
 - 3) Shall be gray in color.
 - 4) Provide Hubbell 1124 Extra Heavy Duty Industrial Grade Series, or approved equal.
- d. Motor Rated Toggle Switches (16140.S10).
- 1) Shall be extra heavy duty AC Manual Motor Controllers series with grounding screw, 30 amperes, 600-volt rated.
 - 2) Single throw, double pole, toggle switch used as a local disconnect for HVAC equipment.
 - 3) Shall be black in color.
 - 4) Provide Hubbell, or approved equal.
- e. Wall Mount, Line Voltage, Cooling Thermostat (16140.T10).
- 1) Provide a wall mounted, line voltage, cooling thermostat as shown on the Drawings.
 - 2) Shall be single pole, rated for 120 volt and the load served with a range of 50 – 90 degrees F.
- f. 2-stage Cooling Thermostat (16140.T20).
- 1) Shall be line voltage, 2-stage, cooling thermostat
 - 2) Shall be a single pole, double throw (SPDT) thermostat rated for no less than 16 amps at 120-volt.
 - 3) Operation shall be stage 1 (low temperature) contacts shall close when temperature rises to low temperature setting and stage 2 remains open. If temperature decreases back below the low temperature setting stage 1 contacts open and stage 2 contacts remain open. Conversely, if the temperature continues to rise above the low temperature setting to the high temperature setting than stage 1 contacts open and stage 2 contacts close.

- 4) Temperature range shall be 50 degrees – 110 degrees F, minimum.
 - 5) Temperature differential shall not exceed 3.5 degrees F.
 - 6) Sensor shall be fixed to the thermostat.
 - 7) The housing shall be steel.
 - 8) Provide Dayton, or approved equal.
- g. Stainless Steel Device Plates (16140.P01).
- 1) Install stainless steel device plates at all indoor locations unless called out otherwise on the drawings.
 - 2) Provide Hubbell smooth metal 302/304 super stainless steel, or approved equal.
- h. Weatherproof Receptacle Device Plates (16140.P11).
- 1) Weatherproof receptacle device plates shall be provided as shown on the drawings and in all locations that may be subjected to damp or wet conditions.
 - 2) Weatherproof receptacle device plates shall be in-use type weatherproof receptacle device plates that allow for weatherproof protection even when a cord is plugged into the device.
 - 3) Weatherproof receptacle device plates shall be metallic.
 - 4) Weatherproof receptacle device plates shall be gasketed.
 - 5) Weatherproof receptacle device plates shall be lockable.
 - 6) Weatherproof receptacle device plates shall be UL Listed.
 - 7) The device plate shall be PVC-coated and of a similar design when installed on PVC-coated boxes.
 - 8) Provide Red Dot model CKMUV, or approved equal.
- i. Weatherproof Switch Device Plates (16140.P20).
- 1) Provide a die cast vertical oriented weatherproof switch device plate that allow for an up/down action on a standard toggle switch installation.
 - 2) The device plate shall allow for switching without lifting a device cover.
 - 3) The device plate shall be PVC-coated and of a similar design when installed on PVC-coated boxes.
 - 4) Provide Red Dot CCT type device plates, or approved equal.

- j. Corrosion Resistant Switch Device Plates (2-gang) (16140.P20).
 - 1) Corrosion Resistant Device Plates shall be provided as shown on the drawings and in all locations that may be subjected to corrosive material.
 - 2) Device plates shall be double-gang (2-gang).
 - 3) Provide a die cast vertical oriented weatherproof switch device plate that allow for an up/down action on a standard toggle switch installation.
 - 4) The device plate shall allow for switching without lifting a device cover.
 - 5) The device plate shall be PVC-coated and of a similar design when installed on PVC-coated boxes.
 - 6) Provide Ocal FS and FD series covers, or approved equal.
- k. Weatherproof Cover (2-Gang) (16140.P15).
 - 1) Weatherproof covers shall be provided as shown on the drawings and in all locations that may be subjected to damp or wet conditions.
 - 2) Weatherproof covers shall be in-use type weatherproof receptacle device plates that allow for weatherproof protection even when a cord is plugged into the device.
 - 3) Weatherproof covers shall be double-gang (2-gang).
 - 4) Weatherproof covers shall be non-metallic.
 - 5) Weatherproof covers shall be gasketed, rated NEMA 3R.
 - 6) Weatherproof covers shall be UL Listed.
 - 7) Provide Commercial Electric, or approved equal.
- l. Device Plate Identification Label (16140.D01).
 - 1) Label all device plates with a vinyl, super adhesive label rated for outdoor use and that is white, 0.375 inches high with 0.25 inch black characters.
 - 2) Provide Brothers product, or approved equal.

2.2 Unit Heaters

- a. Surface Mounted Stainless Steel Fan Forced Heater (16140.H01).
 - 1) Provide stainless steel, electric, fan forced heaters as shown on the Drawings.
 - 2) Shall be 500 watt, 120 volt, surface mounted heaters.

- 3) Heater shall have a squirrel cage blower design with a minimum of 90 CFM capacity.
- 4) The heating element shall have a minimum of 5 year warranty.
- 5) The surface mount enclosure and heater grill shall be stainless steel.
- 6) Provide a King stainless steel, marine environment pick-a-watt, fan forced wall heater, model number PAW1215-SS with a stainless steel surface mount can model number PAWS-SS, stainless steel grill model number PAWG-SS and a two (2) pole integral thermostat kit model number PT-2-SS, or approved equal.

PART 3: EXECUTION

3.1 INSTALLATION

a. General.

- 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
- 2) Devices shall be bonded to their enclosure and the equipment grounding conductor with a separate grounding conductor attached to the device which will allow the device to be detached from the enclosure without disconnecting the equipment grounding conductor from the enclosure.
- 3) The use of the mounting yoke as the only method for bonding is unacceptable.
- 4) Devices that are not installed at the end of the line (circuit) shall be pig-tailed out and the pig-tails shall be connected to the line and load conductors.
- 5) After the pigtailed conductors are terminated on the device and before it is installed in the enclosure the exposed energized parts shall be wrapped with electrical insulating tape with a minimum of three wraps.
- 6) As the device is installed in the enclosure, care shall be taken to neatly fold the conductors inside the enclosure so as to not kink, bind or otherwise damage the sheath of the conductors.
- 7) Terminations on all devices shall be via pressure or compression type connectors. Wrapping conductors around a termination screw and tightening is unacceptable.
- 8) Mounting heights for receptacles shall be 18 inches to center from finished floor unless called out otherwise on the Drawings or specified at different height to meet minimum code requirements. Where countertops are present, receptacles shall be mounted horizontally and mounted 4 inches to center above the back-splash. The CONTRACTOR is responsible to coordinate with the approved casework submittals. Failure to do so will require the CONTRACTOR to relocate devices at their expense.

- 9) Mounting height for switches shall be 46 inches to center above finished grade unless called out otherwise on the Drawings or specified at different height to meet minimum code requirements. Where countertops are present, switches shall be mounted 5 inches to center above the back-splash. The CONTRACTOR is responsible to coordinate with the approved casework submittals. Failure to do so will require the CONTRACTOR to relocate devices at their expense.
- 10) Coordination is the responsibility of the CONTRACTOR. If a conflict exists for the mounting location of devices, the CONTRACTOR shall bring it to the ENGINEER's attention during the rough-in phase and the ENGINEER shall provide direction. Failure to coordinate conflicts during the rough-in phase will result in relocation of devices at the CONTRACTOR's expense.
- 11) Devices shall be installed level and plumb. Devices shall be brought out plumb with the wall surface via UL listed spacers approved for this purpose if necessary.
- 12) Devices shall be tested for voltage, polarity, ground integrity and in the case of GFCI receptacles, that they operate as intended.
- 13) The position of devices, as shown on the Drawings, are general locations only unless dimensioned. The CONTRACTOR is responsible to coordinate with various trades to ensure no conflict exists.

END OF SECTION

SECTION 16150 WIRING CONNECTIONS

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) This Section includes requirements for conductor termination methods.
 - 2) Additional conductor termination means and methods are specified in Sections 13410 Basic Measurement and Control Instrumentation Materials and Methods and Section 13430 Boxes, Control Panels and Control Centers.

1.2 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data

- 1) Pursuant to Section 01300 – Submittal Procedures.
- 2) Manufacturer’s data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2: PRODUCTS

2.1 MATERIALS

- a. Small Compression Connectors (16150.C01).
 - 1) Insulated fork, ring or splicing (butt) connectors shall be provided for # 10 AWG or smaller conductors that splice together or terminate with a screw other than in a terminal block.
 - 2) Connectors shall be properly sized for the conductor and for the stud used.
 - 3) Burndy, Panduit, Thomas and Betts, or approved equal.
- b. Insulated Wire Ferrules (16150.F10).
 - 1) For all conductors terminating on terminal blocks, install crimp-on, insulated plastic sleeve ferrules on each conductor. Install ferrules with a crimping tool provided by the ferrule manufacturer for that purpose.
 - 2) Wire ferrules shall be color coded to match the DIN color code.
 - 3) Weidmuller, Panduit, American Electric, Inc., or approved equal.
- c. Medium and Large Compression Connectors (16150.C10).
 - 1) Non-insulated copper compression connectors shall be provided for # 8 AWG and larger conductors.
 - 2) The connector shall have a voltage and current rating equal to or exceeding the conductor.
 - 3) The barrel shall be long enough to accommodate a minimum of two (2) circumferential crimps.
 - 4) The connectors shall be properly sized for the conductor.
 - 5) Burndy, Panduit, Thomas and Betts, or approved equal.
- d. Electrical Spring Connectors (Wire Nuts) (16150.W01).
 - 1) Provide properly sized spring connectors for the size and number of conductors spliced.
 - 2) Ideal, 3M, Thomas and Betts, or approved equal.

- e. Insulated Mechanical Multi-Tap Connectors (16150.M01).
 - 1) Provide properly sized, insulated, mechanical, multi-tapped connectors for splices.
 - 2) Burndy, Panduit, Thomas and Betts, or approved equal.
- f. Bi-Metal Pin Connector (16150.P51).
 - 1) Barrel shall be manufactured from high strength aluminum alloy.
 - 2) Pigtail shall be manufactured from high conductivity copper.
 - 3) Shall be rated for 600 volts minimum.
 - 4) Clearly marked with wire size and compression die index number for proper crimping.
 - 5) Shall have an insulating cover provided.
 - 6) Shall be rated for copper or aluminum conductors. Tested to UL 486A – 486B Standards.
 - 7) Shall be crimped in the manner and with the die specified by the manufacture.
 - 8) Provide Ilsco type CMP AL/CU Pin, or approved equal.

2.2 ACCESSORIES

- a. Varnished Cambric Tape (16150.T30).
 - 1) Varnished cambric insulating tape shall be bias cotton cambric fabric tape, oil primed and coated with high-grade yellow electrical insulating varnish.
 - 2) The tape shall not contain any adhesives.
 - 3) 3M – Scotch # 2510, or approved equal.
- b. Electrical Tape (16150.T40).
 - 1) General electrical tape shall be premium grade, all weather vinyl electrical insulating tape.
 - 2) 3M – Scotch 33+, or approved equal.
- c. Thin Wall Heat Shrink Tubing (16150.T01).
 - 1) Thin walled heat shrink tubing shall be flame retardant and made of cross-linked polyolefin.

- 2) The tubing shall have a minimum operating temperature of – 55 to + 135 degrees Celsius.
 - 3) Burndy, Panduit, or approved equal.
- d. Heavy Wall Heat Shrink Tubing (16150.T10).
 - 1) Thin walled heat shrink tubing shall be flame retardant and made of cross-linked polyolefin.
 - 2) The inside diameter shall be coated with an adhesive sealant to protect against moisture and corrosion.
 - 3) The tubing shall have a minimum operating temperature of – 55 to + 135 degrees Celsius.
 - 4) Burndy, Panduit, or approved equal.
- e. Heavy Wall Heat Shrinkable End Caps (16150.T20).
 - 1) Heavy walled heat shrink tubing shall be flame retardant and made of cross-linked polyolefin.
 - 2) The inside diameter shall be coated with an adhesive sealant to protect against moisture and corrosion.
 - 3) The tubing shall have a minimum operating temperature of – 55 to + 135 degrees Celsius.
 - 4) Burndy, Panduit, or approved equal.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General
 - 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
 - 2) Care shall be taken when terminating conductors to avoid kinking, cutting or puncturing the jacket or allowing contamination by grease, oil or water.
 - 3) Care shall be taken when terminating conductors to properly support the conductors and to avoid undue pressure on the connector or utilization equipment.
 - 4) Conductors shall be terminated by use of lugs, pressure type connectors wire nuts or terminal blocks. Wrapping conductors around a screw type terminal is not acceptable.

- 5) Insulate all connections and splices with Scotch 33+ tape and Scotchfill, pre-molded plastic covers, or heat shrink tubing and caps.
- 6) Compression connectors shall be installed using the tool and die provided by the same manufacturer as the connectors and as per their directions.
- 7) Compressions on connectors used for # 8 AWG conductors and larger shall have a minimum of two (2) circumferential crimps.
- 8) Indenter type crimps on compression connectors shall not be used on conductors larger than # 10 AWG.
- 9) Additional conductor termination means and methods including terminal blocks and control conductors are specified in Sections 13410 Basic Measurement and Control Instrumentation Materials and Methods and Section 13430 Boxes, Control Panels and Control Centers.
- 10) Connectors shall be installed as per the manufacturer's directions.
- 11) Insulated wire ferrules shall be provided for conductors terminated on terminal blocks utilizing a crimping tool provided by the ferrule manufacture specifically for this purpose.
- 12) Where wire ducts in enclosures exist, conductors shall be grouped together and routed in the wire ducts and shall be fanned out to the terminals.
- 13) Wire nuts shall be used on conductors # 10 AWG or less and only for splicing conductors at light fixtures, at receptacles and motors. No other splicing of conductors with wire nuts are permitted unless specifically identified on the Drawings.
- 14) All spare conductors shall be identified individually, neatly coiled and fastened with cable ties. The coil shall be labeled to describe its origin. Spare conductors shall be left long enough to be neatly routed and terminate anywhere within the enclosure.
- 15) Conductors installed outdoors which are not terminated the same day, shall have heavy wall heat shrinkable end caps installed the same day they are pulled in. The end caps shall remain in place until the day they are terminated.
- 16) Heavy wall heat shrink tubing shall be installed over splices or over the barrel of connectors installed outdoors.
- 17) Thin wall heat shrink tubing shall be installed over splices or over the barrel of connectors installed indoors.
- 18) Thin wall heat shrink tubing shall be installed over twisted shielded pair cable where the cable is stripped back. Reference Section 13410 Basic Measurement and Control Instrumentation Materials and Methods for specifics on this installation.

- 19) As connections are set with a torque wrench, a black felt marker shall be used to mark across the bolt, nut or screw indicating the torque has been set.
 - 20) Insulated Mechanical Multi-Tap Connectors shall be utilized for splices located at in-ground lighting and power boxes. It may also be used for motor terminations.
- b. Terminations For Motors.
- 1) Conductors sized # 10 AWG or less for phase conductors shall be connected with wire nuts set tight. The wire nuts shall be wrapped with premium grade electrical tape with a 50 percent overlap, installed in a clockwise rotation to hold the connector in place and to keep debris out of the connector.
 - 2) The equipment grounding conductor shall be terminated on a lug identified for this use. If the motor is not supplied with a lug, a ring or compression type lug shall be used.
 - 3) Conductors sized larger than # 10 AWG shall be terminated with compression connectors properly sized. The connectors shall be bolted together in a pigtail type fashion using stainless steel bolts, flat washers, lock washers and nuts. They shall have a torque as recommended by the bolt manufacturer for the bolt size used.
 - 4) The bolt shall not be longer than the minimum necessary for the connection. The connectors shall be wrapped with varnished cambric tape with a 50 percent overlap covering the end of the connectors and extending one inch beyond the connector barrel. The varnished cambric tape shall be held in place by two layers of premium quality electrical tape, each layer with a 50 percent overlap.
 - 5) Insulated Mechanical Multi-Tap Connectors may be used for motor terminations in lieu of the compression connectors and varnished cambric tape method.
 - 6) Conductors shall be left as long as practical for termination in the motor terminal box.

END OF SECTION

SECTION 16210
ELECTRICAL UTILITY SERVICES

PART 1: GENERAL

1.1 SUMMARY

- a. The Section includes electrical utility requirements and contact information.

1.2 SYSTEM DESCRIPTION

- a. Electrical Service
 - 1) The CONTRACTOR shall coordinate all work and inspections with the ENGINEER, the local jurisdiction having authority, Pacificorp (PP&L) (electric utility), and the OWNER.
 - 2) The CONTRACTOR is responsible for all costs for this work including fees for permits, and fees for the electric utility.
 - 3) The CONTRACTOR shall provide all necessary installation services that are not provided by the electric utility.
 - 4) The CONTRACTOR shall provide all necessary components that are not provided by the electric utility. All components shall be as specified by the electric utility. Components include conduits, pull rope, vaults, pull boxes, transformer pads, current transformer cabinets, meter socket enclosures, bollards, and ancillary items.
 - 5) The CONTRACTOR shall comply with the electric utility's electric service requirements.
- b. Temporary Service.
 - 1) The CONTRACTOR shall be responsible to coordinate work with the local electrical utility serving the facility.
- c. Approval of Electrical Service Equipment by Electric Utility
 - 1) The CONTRACTOR shall submit the product data for all vaults, lids, CT enclosures, meter bases, switchboards, etc. for review and approval by the electric utility.
 - 2) The CONTRACTOR shall provide dimensioned drawings and elevations of the installation as required by the electric utility.
 - 3) The CONTRACTOR shall obtain written approval of the equipment and installation drawings prior to ordering equipment.

- 4) CONTRACTOR shall be responsible for additional costs related to re-work and schedule delays if they order the equipment without written approval from the electric utility.
- d. Contact Information and Work Orders
 - 1) Work Orders:
 - a) Blower Building: WO # 760 8660
 - b) DAF Building: WO # 760 8662
 - 2) Contact Information:
 - a) Estimator: Lyle “Turk” DeFord II
 - b) Email: Lyle.DeFord_II@pacificorp.com
 - c) Phone: (541) 967-6180
 - d) In the event that the estimator does not respond, contact Pacific Power Builder’s Hotline immediately to coordinate the installation of the new service.
 - (1) +1 (800) 469-3981
 - e) The CONTRACTOR shall immediately contact the electric utility to coordinate the installation of the new service. Time is of the essence. The CONTRACTOR shall be responsible for final coordination, scheduling, and ensuring timely installation of the new utility services.

PART 2: PRODUCTS

2.1 Transformer Vault and Top (16210.V02).

- a. Provide Oldcastle Precast Vault Base # 575-TRANS-PCORP
- b. Provide Oldcastle Vault Top # 7992600
- c. No equal, Pacificorp Standard.

2.2 Utility Pulling Vault (16210.V10).

- a. Provide Oldcastle Precast Incidental Traffic Vault # 776-MH-PCORP.
- b. Provide Oldcastle Vault Top # 7992594.
- c. No equal, Pacificorp Standard.

PART 3: INSTALLATION

3.1 QUALITY CONTROL

- a. All work shall comply with the electric utility’s electrical service requirements, electric utility’s specifications, and the Contract Documents.
- b. CONTRACTOR shall coordinate work with other trades to avoid conflicts, delays and unnecessary interference with operation of the facility during construction.

- c. CONTRACTOR shall provide all materials and incidentals required for a complete and operable system, even if not indicated explicitly by the Contract Documents.
- d. The routing of the conduit is critical and shall be coordinated with the utility, ENGINEER and OWNER.

END OF SECTION

SECTION 16232
PACKAGED DIESEL GENERATOR

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) Requirements for a complete factory assembled generator set with digital electronic generator controls, and digital voltage regulator.
 - 2) The generator and transfer switch shall be of the same manufacturer.
 - 3) Requirements for an outdoor weather-protective enclosure.
 - 4) Requirements for a sub-base fuel tank.

1.2 REFERENCES

- a. The following is a list of Codes and Standards that the packaged diesel generator shall conform to. The generator set shall include necessary features to meet the requirements of these standards.
 - 1) IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
 - 2) NFPA 70 – National Electrical Code
 - 3) NFPA 99 – Essential Electrical Systems for Health Care Facilities, if applicable to this project.
 - 4) NFPA 110 – Emergency and Standby Power Systems, if applicable to this project.
 - 5) NEMA MG1. Alternator shall comply with the requirements of the current edition of this Standard as they apply to AC alternators.
 - 6) UL 142 – Sub-base Tanks.
 - 7) UL 1236 – Battery Chargers.
 - 8) UL 2200 – The generator set shall be list to UL2200.
- b. The generator control system shall comply with the following Codes and Standards.
 - 1) EN 50082-2, Electromagnetic Compatibility, Generic Immunity Requirements, Part 2.
 - 2) EN 55011, Limits and Methods of Measurement of Radio Interference Characteristics.

- 3) FCC Part 15, Subpart B.
 - 4) IEC 8528 Part 4. Control Systems for Generator Sets.
 - 5) IEC Std. 801.2, 801.3 and 801.5 for susceptibility, conducted and radiated electromagnetic emissions.
 - 6) UL 508. The entire control system of the generator set shall be UL 508 listed and labeled.
- c. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying assurance in design/development, production, installation and service in accordance with ISO 9001.

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.

- 2) Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.
- 3) Provide a complete bill of materials. Any differences between products specified and proposed shall be clearly identified.
- 4) Manufacturer's product literature, model specifications and performance data sufficient to verify compliance with items specified in 1.2 References of this Section.
- 5) Complete model number and trip characteristics for the main circuit breaker to be provided.
- 6) Warranty information complying with the requirements of this Section.
- 7) Seismic certification for area installed provided by the manufacturer.
- 8) Seismic calculations for the concrete slab and anchor bolts required. Calculations shall be wet stamped by a Professional Engineer licensed in the State of Oregon.
- 9) Project specific power and control schematic. The schematic shall clearly identify all field wiring termination points using the same identification shown in the Contract Documents.
- 10) The generator, fuel tank and battery charger shall, at a minimum have the following I/O points identified on the schematic.
 - a) Generator H-O-A in hand.
 - b) Generator H-O-A in auto.
 - c) Generator running.
 - d) Generator warning.
 - e) Generator failed.
 - f) Generator low fuel.
 - g) Battery charger failed.
- 11) Submittal shall include a line by line compliance statement based on this specification.
- 12) Manufacturer's document of EPA certification for proposed model generator.
- 13) Outline drawing showing overall dimensions of generator, tank, enclosure and accessories.

1.4 QUALITY ASSURANCE

a. Qualifications.

- 1) The manufacturer of this equipment shall have produced similar equipment for a minimum period of ten years. When requested by the ENGINEER, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

- 2) The generator shall be of the same manufacturer as the transfer switch to provide a single source of warranty responsibility for all the products provided.
 - 3) Generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation and service in accordance with ISO 9001.
- b. Factory Testing.
- 1) The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be shipped with the generator set.
 - 2) Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include; run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup and function of safety shutdowns.
 - 3) Factory testing may be witnessed by the OWNER and/or ENGINEER. Costs for travel expenses will be the responsibility of the OWNER and/or ENGINEER. Manufacturer is responsible to provide a minimum of two weeks notice for factory testing.

1.5 WARRANTY

- a. Generator set, fuels tank, enclosure and accessories specified within this Section shall be warranted for a minimum period of [24-months] [5 years] from the date of substantial completion against all defects in materials and workmanship. The warranty shall be comprehensive including all parts, labor and travel.

1.6 Selective Coordination

- a. The manufacturer of the generator and overcurrent protection device has been designed to comply with the Selective Coordination requirements of the current edition Oregon Specialty Code. Alternate manufacturers shall be considered only under the following conditions:
 - 1) The Contractor shall provide a design of the entire NEC article 701 Legally Required Standby System distribution system to demonstrate compliance with the Selective Coordination Requirements of the current edition of the Oregon Electrical Specialty Code.
 - 2) The Contractor shall provide scaled floorplans demonstrating that the size of the alternate electrical equipment does not exceed the space requirements of the basis of design.
 - 3) The Contractor shall provide a written document stating that the alternate design complies with the Selective Coordination requirements of the current edition of the Oregon Specialty Code. The document shall be signed and stamped by a

licensed Professional Electrical Engineer or Supervising Electrician in the State of Oregon.

- 4) Acceptance of the alternative shall require written approval by the Engineer.

PART 2: PRODUCTS

2.1 GENERATOR SET

a. Generators:

- 1) Blower Building: GEN-2000
 - a) 150kW / 188kVA, 480/277V, 3-phase, 60Hz
 - b) 24 hour regional belly tank with level sensor
- 2) DAF Clarifier: GEN-3000
 - a) 150kW / 188kVA, 480/277V, 3-phase, 60Hz
 - b) 24 hour regional belly tank with level sensor

b. Ratings.

- 1) The generator set shall operate at a voltage as shown on the Drawings.
- 2) The generator set shall be rated as shown on the Drawings. Standby rating, based on site conditions of an altitude of 500 feet above sea level and ambient temperatures up to 104 degrees F.

c. Performance.

- 1) Voltage regulation shall be plus or minus 0.5 % for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 %.
- 2) Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with steady state no load to steady state rated load shall not exceed plus or minus 0.5%.
- 3) The diesel engine generator set shall accept a single step load of 100 % nameplate kW and power factor, less applicable de-rating factors, with the engine generator set at operating temperature.
- 4) Motor starting capability shall be a minimum of 607 kVA. The generator set shall be capable of recovering to a minimum of 90 % of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set. Maximum voltage dip on application of this load, considering both alternator performance and engine speed changes shall not exceed 25 %.
- 5) The alternator shall produce a clean AC voltage waveform, with no more than 5 % total harmonic distortion at full linear load when measured from line to

neutral, and no more than 3 % in any single harmonic and no third order harmonics or their multiples. Telephone influence factor shall be less than 40.

- 6) The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating and shall meet all applicable exhaust emission requirements at the time of commissioning.

d. Construction.

- 1) The engine generator set shall be mounted on a heavy duty steel base to maintain alignment between components. Provide vibration isolators between the engine generator assembly and the structural base. The base shall incorporate a battery tray with hold down clamps within the rails.

2.2 ENGINE AND ENGINE EQUIPMENT

- a. The engine shall be diesel, 4 cycle, radiator and liquid cooled, producing 1.5 HP per kW to operate at 1800 rpm for full electrical output rating. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories.
- b. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of the engine coolant temperature to provide fast stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed and accelerating to rated speed.
- c. Skid mounted radiator and cooling system rated for the full load operation in 122 degrees F ambient as measured at the alternator air inlet. Radiator shall be prototype tested to verify cooling performance of the engine, radiator and fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange if generator is to be installed indoors. The equipment manufacturer shall fill the cooling system with a 50/50 ethylene glycol / water mixture prior to shipping. Rotating parts shall be guarded against accidental contact.
- d. Electric starter(s) capable of three complete cranking cycles without overheating.
- e. Provide with full flow lubrication oil filters with replaceable spin on canister elements.
- f. An engine driven, mechanical, positive displacement fuel pump. Provide fuel filter with replaceable spin on canister element. Fuel cooler if required for operation due to the design of the engine and the installation.
- g. Provide replaceable dry element air cleaner with restriction indicator.
- h. Engine battery charging alternator, 40 ampere minimum and solid state voltage regulator.
- i. Flexible supply and return fuel lines.

2.3 AC ALTERNATOR

- a. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL 1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees C.
- b. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of providing sufficient excitation for the alternator to supply approximately 300 % of rated current for up to 10 seconds.

2.4 GENERATOR SET CONTROL

- a. The generator set shall be provided with a microprocessor based control system that is designed to provide automatic starting, monitoring, protection and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set and remote monitoring and control as described in the specification.
- b. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all the components in the system under the vibration conditions encountered. All switches, lamps and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control, with the door open, that operate in excess of 50 volts.
- c. The generator control enclosure which contains all operator interface switches, lamps, emergency stop switch and accessories listed below, shall be mounted no more than seventy-five (75) inches to the top, above finished floor after the generator set has been installed on a belly tank, isolation springs or other devices specified herein and/or shown on the Drawings.
- d. Requirements for control switches are listed below.
 - 1) Mode select switch. The mode select switch shall initiate the following control modes. When in the run or manual position the generator set shall start and accelerate to rated speed and voltage as directed by the operator. A separate pushbutton to initiate starting is acceptable. In the off position the generator set shall immediately stop bypassing all time delays. In the auto position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - 2) Emergency stop switch. Switch shall be red mushroom-head pushbutton. Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.

- 3) Reset switch. The reset switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - 4) Panel lamp switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed or after the switch is depressed a second time.
 - 5) Voltage and frequency adjustment. The generator set control shall include digital raise / lower switches for adjustment of voltage and frequency.
- e. Generator Set AC Output Metering.
- 1) The generator set shall be provided with a metering set including the following features and functions.
 - a) Digital metering set, 1 % accuracy to indicate generator RMS voltage and current, frequency and total load on the generator set.
 - b) Generator set alarm and status display.
- f. Generator Set Alarm Status Display.
- 1) The generator set control shall include LED alarm and status indication lamps. The lamps shall be high intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. At a minimum, the control shall have separate indication lamps to indicate the following.
 - a) Not in Auto.
 - b) Shutdown.
 - c) Warning.
 - d) Remote Start.
 - e) Auto mode.
 - f) Manual run.
 - 2) The generator set control shall indicate the existence of warning and shutdown conditions on the generator set control panel for all the following conditions.
 - a) Low oil pressure (warning and shutdown).
 - b) High coolant temperature (warning and shutdown).
 - c) Over current (warning and shutdown).
 - d) Oil pressure sender failure (warning).
 - e) Low coolant temperature (warning).
 - f) Low and high battery voltage (warning).
 - g) Weak battery (warning).
 - h) Low fuel level (warning).
 - i) Engine temperature sender failure (warning).
 - j) Low coolant level (shutdown).
 - k) Fail to crank (shutdown).
 - l) Fail to start/over-crank (shutdown).
 - m) Over-speed (shutdown).
 - n) Low and high AC voltage (shutdown).
 - o) Over and under frequency (shutdown).
 - p) Field overload (shutdown).

- q) Loss of sensing voltage (shutdown).
 - r) Emergency stop (shutdown).
 - 3) The control system shall incorporate data logging of alarm conditions.
 - 4) Provisions shall be made for indication of customer specified alarm conditions as identified in 1.3 Submittals in this specification, but in no case shall there be less than a minimum of four (4) customer specified alarm or shutdown conditions.
- g. Engine Status Monitoring.
- 1) The following information shall be available from the alphanumeric display panel on the generator set control.
 - a) Engine oil pressure.
 - b) Engine coolant temperature.
 - c) Engine speed (rpm).
 - d) Number of hours of operation.
 - e) Number of start attempts.
 - f) Battery voltage.
- h. Engine Control Functions.
- 1) The control system shall include a cycle cranking system which allows for user selected crank time, rest time and number of cycles. Initial settings shall be for three cranking periods of fifteen seconds each with fifteen second rest period between cranking periods.
 - 2) The control system shall include the engine governor control which functions to provide steady state frequency regulation as noted elsewhere in this specification.
 - 3) The control system shall include sender failure monitoring logic which is capable of discriminating between failed sender or wiring components and an actual failure condition.
 - 4) The control system shall include time delay start (adjustable from 0 to 300 seconds) and time delay stop (adjustable from 0 to 600 seconds) functions.
- i. Alternator Control Functions.
- 1) The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from mis-operation due to load induced voltage waveform distortion and provide pulse width modulated output to the alternator exciter. The voltage regulation system shall control buildup of AC generator voltage to provide linear rise and limit overshoot. The system shall include a torque matching characteristic which shall reduce output voltage in proportion to frequency below adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll off frequency and rate and be capable of being curve matched to the engine torque curve with adjustments in the field. The voltage regulator shall include

adjustments for gain, damping and frequency roll off. Adjustments shall be made via digital raise/lower switches with an alphanumeric LED readout to indicate setting level.

- 2) A microprocessor based protection device shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load exceeds 110 % of the rated current of the generator set for more than sixty seconds. The device shall shutdown and lock out the generator set when output current approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance with the requirements of NFPA 70 (NEC) Article 445.
- 3) The control shall provide alternator protection from the following conditions.
 - a) High or low voltage.
 - b) Over or under frequency.
 - c) Over current warning or shutdown.
 - d) Loss of voltage sensing.
 - e) Field overload shutdown.
- 4) A microprocessor based AC over / under voltage monitoring system that responds only to true RMSD voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110 % of the operator set point voltage level for more than ten seconds or with no intentional delay when voltage exceeds 130 %. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85 % for more than ten seconds.

j. Control Interfaces For Remote Monitoring.

- 1) The control system shall include a configurable digital input/output module for expanded monitoring of generator set functions and alarms. The I/O module shall include eight form C relay output sets and four discrete contact inputs. Provide the following discrete output alarms from the generator set.
 - a) Generator H-O-A in hand.
 - b) Generator H-O-A in auto.
 - c) Generator running.
 - d) Generator warning.
 - e) Generator failed.
 - f) Generator low fuel.
 - g) Battery charger failed.

2.5 Other Equipment to be Provided with the Generator Set.

a. Alternator Protection Relay

- 1) The generator set shall be provided with an inherent alternator protection relay. The use of a molded case generator output circuit breaker shall not be acceptable.
- 2) The relay shall provide overload protection of the generator and generator feeder conductors, per the NEC.

- 3) The relay shall provide short circuit and ground fault protection.
 - 4) The relay trip curve shall be adjustable to achieve selective coordination.
 - 5) The relay shall selectively coordinate per the NEC and the Oregon Electrical Specialty Code.
 - 6) The generator shall be provided with a disconnect capable of being locked in the open position. This disconnecting means shall not consist of a circuit breaker. The disconnecting means shall comply with the NEC and the Oregon Electrical Specialty Code.
 - 7) The alternator protection shall be Cummins Amp Sentry.
- b. Outdoor Weather Protective and Sound Attenuation Enclosure.
- 1) The generator set shall be provided with an outdoor enclosure (housing) with the entire package listed under UL 2200. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 100 degrees F. The housing shall have lockable hinged access doors as required to maintain easy access for all operating and service functions. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure.
 - 2) The outdoor weather protective enclosure shall be made of steel.
 - 3) Provide a sound Level 2 enclosure. The enclosure shall be insulated with non-hygroscopic materials and reduce the sound level of the generator set while operating at full rated load to a maximum of 72 dBA as measured at seven meters from the generator set in a free field environment.
 - 4) All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two step electro-coating paint process. Listed below is the minimum level of performance for the painting process.
 - a) Primer thickness, 0.5 – 2.0 mils. Top coat thickness, 0.8 -1.2 mils.
 - b) Gloss, per ASTM D523-89, 80 % plus or minus 5 %. Gloss retention after one year shall exceed 50 %.
 - c) Cross hatch adhesion, per ASTM D3359-93, 4B-5B.
 - d) Impact resistance, per ASTM D2794-93, 120-160 inch pounds.
 - e) Salt spray, per ASTM B1117-90, 1000+ hours.
 - f) Humidity, per ASTM D2247-92, 1000+ hours.
 - g) Water soak, per ASTM D2247-92, 1000+ hours.
 - 5) All external enclosure hardware shall be corrosion resistant and hinges shall be stainless steel.
 - 6) A factory mounted exhaust silencer shall be mounted inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.

- 7) The enclosure shall include a flexible oil drain line that extends to the exterior of the enclosure. The enclosure shall include an external radiator fill provision.

c. Diesel Fuel Tank

- 1) Provide a dual wall sub-base fuel storage tank sized to allow for full load operation of the generator set for twenty-four (24) hours at full load. The tank shall be constructed of corrosion resistant steel and shall be UL listed. The equipment, as installed by the CONTRACTOR shall meet all local and regional requirements for the application. The tank shall include all the features listed below.
- 2) The tank shall be considered “regional” and the dimensions of the tank shall permit installation of the normal and emergency tank vents without penetrating the generator enclosure, as required by all local and state codes.
- 3) The tank shall be provided with all normal and emergency vent piping as required by the Oregon Fire Code and to the satisfaction of the local AHJ.
- 4) Emergency tank and basin vents, mechanical level gauge and basin drain.
- 5) Fuel supply and return lines connected to generator set with flexible lines as recommended by the engine manufacturer and in compliance with UL 2200 and NFPA 37 requirements.
- 6) Leak detection provision and high and low fuel level float switches wired to the generator set control for local and remote alarm indication.

d. Generator Batteries and Charger

- 1) Provide engine starting batteries. Starting batteries shall be lead-acid, 12 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of three complete fifteen second cranking cycles at 40 degrees F ambient temperature when fully charged.
- 2) Provide a fully automatic battery charger, sized as appropriate for the engine and batteries, as recommended by the engine manufacturer. The charger shall be UL labeled for use in emergency applications and shall include all features necessary to meet NFPA 110 requirements. The charger shall be provided with remote indication of battery charger fail alarm.

e. Generator Heaters

- 1) Coolant Heater: Thermostatically controlled UL 499 listed coolant heater, sized as recommended by the engine manufacturer to warm the engine to a minimum of 104 degrees F in an ambient temperature of 40 degrees F and in compliance with NFPA 110. Voltage shall be as identified in the Drawings. Coolant heater shall have provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set.

f. Fuel Tank Level Transmitter

- 1) Level transmitter shall be installed inside the fuel tank and provide real-time level of the diesel fuel.
- 2) Provide an ultrasonic level transmitter capable of continuous level measurement up to 48”.
- 3) Transmitter supply voltage shall be 24VDC.
- 4) Transmitter shall provide a 4-20mA signal output.
- 5) Transmitter housing shall be Type 6P polycarbonate rated for corrosive environments.
- 6) Provide fittings as required for installation inside fuel tank.
- 7) Provide Echopod DL14, or approved equal.

2.6 Seismic Bracing

- a. Provide seismic bracing for the generator set required by the International Building Code and Oregon Structural Specialty Code.
- b. The design of the seismic anchoring and bracing system shall be by a licensed Structural Engineer in the State of Oregon. The CONTRACTOR shall arrange and pay for the services of the licensed Engineer.
- c. Wet stamped and signed calculations and drawing of the seismic anchoring and bracing system shall be submitted to the Engineer for review and approval
- d. Include Manufacturer's seismic certificate.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General.
 - 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
 - 2) Equipment shall be installed by the CONTRACTOR in accordance with the final approved submittals, manufacturer’s instructions and Contract Documents.
 - 3) Installation of equipment shall include furnishing and installing all interconnecting conduits and wiring between all equipment provided for the on-site power system.

- 4) Equipment shall be installed be permanently fastened to the concrete pad in accordance with the manufacturer's instructions which are specified to meet the seismic requirements for the environment and location installed.
- b. Field Quality Control.
- 1) The local authority having jurisdiction shall approve the installation of the generator set and transfer switch before they are energized.
- c. Start-up and Testing
- 1) An authorized employee of the manufacturer's service division shall perform the start-up and testing services. The start-up and testing period shall last a minimum of 8 hours on site.
 - 2) The start-up and testing period shall be a separate day from the demonstration and training period.
 - 3) The CONTRACTOR shall notify the ENGINEER a minimum of two weeks in advance of the start-up and testing schedule to allow for witnessing of the tests.
 - 4) Provide a signed certificate stating the installation meets or exceed the manufacturer's installation standards and instructions.
 - 5) Start-up shall include a "cold start" test.
 - 6) Start-up shall verify all local and remote warnings, shutdowns and alarming events are operating as specified.
 - 7) Perform a power failure test on the entire installed system. The test shall be conducted by opening the power supply from the utility service and observing proper operation of the system for at least thirty minutes.
 - 8) Reference the Start-up and Testing specification Section in the Contract Documents for a detailed check list for all processes on the project. The Contractor shall go through the check list to verify compliance and that ask the ENGINEER to witness the tests as the CONTRACTOR goes through them a second time.
 - 9) Coordinate start-up and testing with the transfer switch start-up.
 - 10) Startup shall include operating the generator set with a load bank connected and operating at full load for a minimum of four continuous hours.
 - 11) The CONTRACTOR is responsible to provide diesel fuel for the start-up and testing activities. After start-up and testing is completed and accepted and before substantial completion, the CONTRACTOR shall completely fill the diesel fuel tank.
 - 12) Verification that the generator set and associated specified components are operating as specified.

- 13) Provide a printout of all as-commissioned adjustable set points for future reference.
- d. Seismic Anchoring and Bracing
- 1) The design of the seismic anchoring and bracing system shall be by a licensed Structural Engineer in the State of Oregon. The CONTRACTOR shall arrange and pay for the services of the licensed Engineer.
 - 2) Wet stamped and signed calculations and drawing of the seismic anchoring and bracing system shall be submitted to the Architect and Engineer for review and approval.
- e. Demonstration and Training.
- 1) An authorized employee of the manufacturer's service division shall perform the demonstration and training services. The demonstration and training period shall last a minimum of 8 hours and shall be provided on site.
 - 2) The demonstration and training period shall be a separate day from the startup and testing period.
 - 3) The OWNER reserves the right to video tape the demonstration and training presentation for future in-house use.
 - 4) Provide training handouts for 10 persons.

END OF SECTION

SECTION 16410
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1: GENERAL

1.1 SUMMARY

- a. Section includes the following enclosed low voltage components rated at 600 VAC or less:
 - 1) Heavy duty single throw, fused, safety switch.

1.2 REFERENCES

- a. National Fire and Protection Association (NFPA)
 - 1) 70 - National Electrical Code (NEC)
- b. National Electrical Manufacturers Association (NEMA).
 - 1) B 3-2001 - Molded Case Circuit Breakers and Their Application.
 - 2) AB 4-2001 - Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
 - 3) KS 1-2001 - Enclosed and Miscellaneous distribution Equipment Switches (600 Volts Maximum).

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not

clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

- 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
- 1) Pursuant to Section 01300 – Submittal Procedures.
 - 2) Manufacturer’s data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.
- e. Shop Drawings
- 1) Back panel and enclosure layouts including interior and exterior front and side exterior view details showing maximum overall dimensions.
 - 2) For enclosure weighing 150 pounds and over, provide physical properties, handling and mounting data including total weight, lifting instructions, height, and floor space required. Mounting requirements for seismic zone 4.
 - 3) All drawings shall list the equipment number.
 - 4) Component designations, shall match those shown on the Drawings.
- f. Quality Assurance/Control Submittals
- 1) Manufacturer’s Instructions
 - a) List special requirements or restrictions of the motor/load combination.
 - b) Submit copy of the manufacturer’s operating and maintenance manuals and, installation instructions.
- g. Main Service Disconnect - ATS Withstand Current Rating Compatibility
- 1) Where a Main Service Disconnect is installed upstream of an Automatic Transfer Switch, the CONTRACTOR shall verify that the proposed disconnect device is listed on the ATS manufacturer's current approved breaker or fuse list per UL 1008. Written confirmation from the ATS manufacturer shall be submitted with the service disconnect submittal identifying the following:
 - a) Disconnect device manufacturer, model, and catalog number
 - b) ATS manufacturer and model number it protects
 - c) The manufacturer's current approved device document number and revision confirming the proposed device is listed as approved.

- 2) Submittals that do not include this written confirmation will be rejected as incomplete.

1.4 QUALITY ASSURANCE

a. Regulatory Requirements

- 1) Products shall be UL listed.

1.5 DELIVERY, STORAGE, AND HANDLING

a. Storage and Protection

- 1) Products shall be stored and installed in a dry environment maintained at 65 degrees F or above.

1.6 ATS WITHSTAND CURRENT COORDINATION

- a. Where a Main Service Disconnect is installed upstream of an Automatic Transfer Switch, the CONTRACTOR shall verify that the proposed disconnect device is listed on the ATS manufacturer's current approved breaker or fuse list per UL 1008.
- b. Written confirmation from the ATS manufacturer shall be submitted with the service disconnect submittal identifying the following:
 - 1) Disconnect device manufacturer, model, and catalog number
 - 2) ATS manufacturer and model number it protects
 - 3) The manufacturer's current approved device document number and revision confirming the proposed device is listed as approved.

PART 2: PRODUCTS

2.1 MANUFACTURED UNITS

- a. Heavy Duty Fused Safety Switch (16410.S01).
 - 1) Heavy duty fused safety switches shall be provided as shown on the Drawings.
 - 2) Heavy duty fused safety switches shall be rated for the load served and shall switch all the phase conductors.
 - 3) Heavy duty fused safety switches shall include separate, unswitched, neutral and ground buses where applicable.
 - 4) Heavy duty fused safety switches shall be fused type and provided with appropriate fuses for the application and AIC rating Heavy duty fused safety switches shall be wall-mount type.
 - a) Switch shall accept Type H or Type L fuses.

- b) Provide fuses with rating as indicated on the Drawings for all safety switches.
 - 5) Heavy duty fused safety switch enclosures installed outdoors shall be rated NEMA 3R or NEMA 4X stainless steel per the Plant Area Work requirements table in Section 16050.
 - 6) Heavy duty fused safety switch enclosures installed indoors shall be rated NEMA 12.
 - 7) Heavy duty fused safety switch ground bus shall be large enough to accommodate terminations for all grounding conductors.
 - 8) Provide Eaton, or approved equal.
- b. Heavy Duty Non-Fused Safety Switch (16410.S05).
- 1) Heavy duty safety switches shall be provided as shown on the Drawings.
 - 2) Heavy duty safety switches shall be rated for the load served and shall switch all the phase conductors.
 - 3) Heavy duty safety switches shall include separate, unswitched, neutral and ground buses where applicable.
 - 4) Heavy duty safety switches shall be wall-mount type.
 - 5) Heavy duty safety switch enclosures installed outdoors shall be shall be rated NEMA 3R or NEMA 4X stainless steel per the Plant Area Work requirements table in Section 16050.
 - 6) Heavy duty safety switch enclosures installed indoors shall be rated NEMA 12.
 - 7) Heavy duty safety switch ground bus shall be large enough to accommodate terminations for all grounding conductors.
 - 8) Provide Eaton, or approved equal.
- c. Enclosed Circuit Breaker (16410.B01).
- 1) Enclosed circuit breakers shall be provided as shown on the Drawings.
 - 2) Enclosed circuit breakers shall be rated as shown on the Drawings.
 - 3) Enclosed circuit breakers shall be UL listed as “Suitable for use as Service Entrance Equipment”, where required.
 - 4) Enclosed circuit breaker enclosures installed outdoors shall be shall be rated NEMA 3R or NEMA 4X stainless steel per the Plant Area Work requirements table in Section 16050.

- 5) Enclosed circuit breaker enclosures shall be NEMA 12 surface mount for indoor installations.
 - 6) Enclosed circuit breakers breaker shall be molded case with an LSI(G) electronic trip unit.
 - 7) Enclosed circuit breakers breaker terminals shall be rated for use with 75° C. wire.
 - 8) Enclosed circuit breakers breaker handle shall be capable of being locked out in the OFF position.
 - 9) Enclosed circuit breakers breaker shall indicate on/ tripped/ off status according to the position of the operating handle.
 - 10) Enclosed circuit breakers grounded conductor connection shall be copper.
 - 11) Enclosed circuit breakers shall be listed on the ATS manufacturer's current approved breaker list per UL 1008 where installed upstream of an Automatic Transfer Switch.
 - 12) Provide Eaton Cutler Hammer or approved equal.
- d. Meltric Cord and Plug Assembly (16410.R01).
- 1) Provide a cord and plug assembly for each pump cord.
 - 2) Cord and plug assembly shall be rated IP67.
 - 3) Shall be horsepower rated per UL 1682, 98 and 508A and NEC 430.
 - 4) Shall perform as a true functioning disconnect switch for motor and inductive loads without the need for an electrical or mechanical interlock.
 - 5) Shall make or break up to 1000 VAC and up to one and a half times the rated current of the assembly.
 - 6) Dead front construction to prevent user access to live parts.
 - 7) Silver-nickel (85/15) butt-style spring loaded contacts.
 - 8) Provide pilot contacts as required for auxiliary contacts, motor over-temperature sensors, moisture leak sensors, and other control features required by the Pump Manufacturer.
- e. Disconnect Stand (16410.S01).
- 1) Provide a lockable pump disconnect panel stand as shown on the Drawings.
 - 2) The disconnect panel stand shall be constructed of 304 stainless steel.

- 3) The disconnect panel stand shall be the same width and depth as the disconnect panel.
- 4) The bottom of the disconnect panel shall be mounted a minimum of 48 inches above the bottom of the Pump Station and surrounding grade.
- 5) The disconnect panel stand shall extend from the bottom of the disconnect panel to the finish grade on top of the Pump Station structural slab.
- 6) The entire front panel of the stand shall be a lockable, hinged door capable of opening 180 degrees, and shall not result in any gaps when the door is closed. The door shall include a padlock hasp.
- 7) The stand frame shall be constructed using stainless steel tube, angle, or bars. The sides of the stand and the door shall be enclosed with stainless steel expanded mesh or perforated sheets.

PART 3: EXECUTION

3.1 INSTALLATION

- a. All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
- b. Install switches and circuit breakers as indicated on the Drawings.
- c. Turn generator reverse service plugs over to owner for use on their portable generator.
- d. Install equipment level and plumb.
- e. Provide nameplates as indicated on the Drawings.

3.2 ADJUSTING

- a. Adjustable features such as the trip setting for a circuit breaker shall be adjusted pursuant to the manufacturer's instructions.

END OF SECTION

SECTION 16416
AUTOMATIC TRANSFER SWITCH

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
- 1) Provide a complete factory assembled automatic transfer switch with field programmable digital electronic controls designed for fully automatic operation. Controls shall include surge voltage isolation, voltage sensors on all phases of both sources, AC powered operator, positive mechanical and electrical interlocking and mechanically held contacts for both sources.
 - 2) The transfer switch and generator set shall be of the same manufacturer to provide a single source of responsibility for all the products provided. Technicians shall be specifically trained, tested and certified to support the products. Technicians shall be employed by the generator set supplier.

1.2 REFERENCES

- a. The following is a list of Codes and Standards that the transfer switch shall conform to.
- 1) UL1008 – Transfer switch. Transfer switches and enclosures shall be UL-1008 listed as a package and labeled to be suitable for use in either optional standby or legally required emergency applications.
 - 2) IBC2006 – Transfer switch shall be prototype tested and third party certified to comply with the requirements of the IBC group III or IV, category D/F. The equipment shall be provided with installation instructions necessary to attain installation compliance.
 - 3) CSA 282, Emergency Electrical Power Supply for Buildings.
 - 4) NFPA 70, National Electrical Code.
 - 5) NFPA 99, Essential Electrical Systems for Health Care Facilities.
 - 6) NFPA 110, Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems.
 - 7) IEEE 446, Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
 - 8) NEMA ICS 10-1993, AC Automatic Transfer Switches.
- b. The transfer switch shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation and service in accordance with ISO9001.

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- b. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- c. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.
 - 2) Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.
 - 3) Seismic calculations for the concrete slab and anchor bolts required. Calculations shall be wet stamped by a Professional Engineer licensed in the State of Oregon.
 - 4) Manufacturer's data including materials of construction, equipment weight, and related information for each item specified.
 - 5) Provide a complete bill of materials. Any differences between products specified and proposed shall be clearly identified.
 - 6) Manufacturer's product literature, model specifications and performance data sufficient to verify compliance with items specified in 1.2 References of this Section.

- 7) Upstream Protective Device Compatibility
 - a) The CONTRACTOR shall verify that the overcurrent protective device installed on the line/normal side of each Automatic Transfer Switch is listed on the ATS manufacturer's current approved breaker or fuse list and meets the withstand current rating requirements of UL 1008.
 - b) The CONTRACTOR shall coordinate between the ATS supplier and the electrical gear supplier to confirm compatibility prior to equipment procurement.
 - c) As part of the ATS submittal, the CONTRACTOR shall provide written confirmation from the ATS manufacturer identifying the following:
 - (1) ATS manufacturer and model number
 - (2) Specific upstream overcurrent protective device catalog number being proposed
 - (3) The manufacturer's current approved device document number and revision confirming the proposed device is listed as approved
 - (4) The withstand current rating of the ATS with the proposed upstream device.
 - d) Submittals that do not include this written confirmation will be rejected as incomplete.
- 8) Warranty information complying with the requirements of this Section.
- 9) Project specific power and control schematic. The schematic shall clearly identify all field wiring termination points using the same identification shown in the Contract Documents.
- 10) The automatic transfer switch shall, at a minimum have the following I/O points identified on the schematic.
 - a) Generator start output.
 - b) Utility power loss (source 1).
 - c) ATS on utility power (source 1).
 - d) ATS on Generator power (source 2).
- 11) Submittal shall include a line by line compliance statement based on this specification.

1.4 QUALITY ASSURANCE

a. Qualifications

- 1) The manufacturer of this equipment shall have produced similar equipment for a minimum period of ten years. When requested by the ENGINEER, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- 2) The automatic transfer switch shall be of the same manufacturer as the generator to provide a single source of warranty responsibility for all the products provided.

- 3) Transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation and service in accordance with ISO 9001.
- b. Factory Testing.
 - 1) The transfer switch manufacturer shall perform a complete operational test on the transfer switch prior to shipping from the factory. A certified test report shall be shipped with the transfer switch.

1.5 WARRANTY

- a. Transfer switch shall be warranted for a minimum period of 5 years from the date of substantial completion against all defects in materials and workmanship. The warranty shall be comprehensive including all parts, labor and travel.

1.6 WITHSTAND CURRENT RATING COORDINATION

- a. The CONTRACTOR shall verify that the overcurrent protective device installed on the line/normal side of each Automatic Transfer Switch is listed on the ATS manufacturer's current approved breaker or fuse list and meets the withstand current rating requirements of UL 1008.
 - 1) The CONTRACTOR shall coordinate between the ATS supplier and the electrical gear supplier to confirm compatibility prior to equipment procurement.
- b. As part of the ATS submittal, the CONTRACTOR shall provide written confirmation from the ATS manufacturer identifying the following:
 - 1) ATS manufacturer and model number
 - 2) Specific upstream overcurrent protective device catalog number being proposed
 - 3) The manufacturer's current approved device document number and revision confirming the proposed device is listed as approved
 - 4) The withstand current rating of the ATS with the proposed upstream device.
 - 5) Submittals that do not include this written confirmation will be rejected as incomplete.

PART 2: PRODUCTS

2.1 Automatic Transfer Switch

- a. Ratings
 - 1) Shall be rated as shown on the Drawings.
 - 2) Transfer switch shall open (in-phase) or programmed transition OTEC.

- 3) Enclosure shall be painted steel NEMA 12 minimum.
- 4) Main contacts shall be rated for 600 volts AC minimum.
- 5) Transfer switch shall be rated to carry 100 percent of the rated current continuously in the enclosure specified, ambient temperatures of – 40 to + 60 degrees C and relative humidity up to 95 percent and altitudes up to 10,000 feet above sea level.
- 6) Shall comply with Level 1 equipment per NFPA 110 and shall be UL 1008 Listed.
- 7) Resistance to Damage by Voltage Transients:
 - a) 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.
- 8) Relay signal:
 - a) Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project.
- 9) Neutral bus shall carry 100% of load.

2.2 Transfer Switch Withstand Current Rating Compatibility

- a. The withstand rating shall be sized based on the available in-rush current of the normal power source and the generator, whichever is greater in RMS symmetrical amperes.
- b. The transfer switch UL 1008 WCR ratings for use with protective devices at installation locations under specified fault conditions.
- c. The overcurrent protective device installed on the line/normal side of each Automatic Transfer Switch shall be listed on the ATS manufacturer's current approved breaker or fuse list and meets the withstand current rating requirements of UL 1008.
- d. The overcurrent protective devices installed on the line/emergency side of the each Automatic Transfer Switch shall be listed on the ATS manufacturer's current approved breaker or fuse list and meets the withstand current rating requirements of UL 1008.

2.3 Transfer Switch Control

- a. Operator Panel.
 - 1) Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel that is permanently labeled for switch and control functions. The operator shall be provided with the following features and capabilities.
 - a) High intensity LED lamps to indicate source 1 and source 2 available and which of the two sources the load is connected to. Source available LED

indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.

- b) High intensity LED lamp to indicate that the control system is testing or exercising the generator set.
- c) A “TEST” pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for a test with or without a load.
- d) A “RESET/LAMP TEST” pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.
- e) The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred and the total number of times each source has failed. This information shall be available via a PC-based service tool and the integral operator display panel.
- f) Display real time clock data including date and time in hours, minutes and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
- g) Display service history for the transfer switch. Display source connected hours to indicate the total number of hours connected to each source. Display number of times transferred and total number of times each source has failed.
- h) Display fault history on the transfer switch including condition, date and time of fault. Faults to include controller check sum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, and network communications error.
- i) Vacuum fluorescent alphanumeric display with pushbutton navigation switches. The display shall be clearly visible in both bright and no light conditions. It shall be visible over an angle of not less than 120 degrees.
- j) The alphanumeric display shall display source condition information including AC voltage for each phase of normal and emergency source and frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance. Line to neutral voltages shall be displayed for 4-wire systems.
- k) The alphanumeric display shall display the source status to indicate source is connected or not connected.
- l) The alphanumeric display shall display load data including three phase AC voltage, three phase AC current frequency, KW, KVA and power factor. Voltage and current data for all phases shall be displayed on a single screen.
- m) The alphanumeric display panel shall allow the operator to view and make adjustments in the control system after entering an access code. The adjustments shall include adjusting voltage and frequency operation set points, set up time clock functions, set up load sequence functions, enable or disable control functions and set up exercise and load test operation conditions as well as normal system time delays for transfer time, time delay start, stop, transfer and retransfer.

b. Internal Controls.

- 1) The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 volts AC. Provide RMS voltage sensing and metering that is accurate to within plus or minus 1 % of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
- 2) Transfer switch voltage sensors shall be close differential type providing source availability information to the control system based on the following functions.
 - a) Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98 % of the normal voltage level and dropout in a range of 75 to 98 % of normal voltage level).
 - b) Monitoring all phases of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98 % of the normal voltage level and dropout in a range of 75 to 98 % of normal voltage level).
 - c) Monitoring all phases of the normal service (source 1) and emergency service (source 2) for loss of a single phase.
 - d) Monitoring all phases of the normal service (source 1) and emergency service (source 2) for overvoltage conditions (adjustable for dropout over a range of 105 to 135 % of the normal voltage and pickup at 95 to 99% of dropout voltage level).
 - e) Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over or under frequency conditions.
- 3) All transfer switch sensing shall be configurable from a windows XP or later PC-based service tool to allow setting of levels and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.
- 4) The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature. A phase band monitor or similar device is not an acceptable alternate for this feature.
- 5) The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0 to 15 seconds), transfer (adjustable in a range from 0 to 120 seconds), retransfer (adjustable in a range from 0 to 30 minutes), and generator stop (cool down) (adjustable in a range from 0 to 30 minutes).
- 6) The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service

- 7) The control shall have optically isolated inputs, high isolation transformers for AC inputs and relays on all outputs to provide optimum protection from line voltage surges, RFI and EMI.
 - 8) The control system shall be designed and prototype tested for operation in ambient temperatures from -30 to + 60 degrees C and up to 95 % humidity. It shall be designed and tested to comply with the requirements of the noted voltage and RFI /EMI standards.
- c. Control Interface.
- 1) The transfer switch shall provide an isolated relay contact for starting of a generator set. The relay shall be normally held open and close to start the generator set. Output contacts shall be form C for compatibility with any generator set.
 - 2) Provide one set of form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps at 250 volts AC.
 - 3) The transfer switch shall provide relay contacts to indicate the following conditions; source 1 (normal service) available, source 2 (emergency service) available, load connected to source 1 (normal service) and load connected to source 2 (emergency service).
 - 4) The transfer switch shall provide a relay contact signal prior to transfer or retransfer. The time period before and after transfer shall be adjustable in a range of 0 to 50 seconds.

2.4 ENCLOSURE

- a. The enclosure shall provide wire bending space in compliance with the latest edition of the NEC. The cabinet door shall include a permanently mounted key type latch(es). Bolted covers or doors are not acceptable.
- b. Manual operating handles shall be accessible to authorized personnel only by opening the key locking cabinet door. Transfer switches with manual operating handles and /or non key operated switches located on the outside of the cabinet do meet this specification requirement and are not acceptable.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General.
 - 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
 - 2) The transfer switch shall be installed per the manufacturer's instructions.
 - 3) The transfer switch shall be installed as per the Drawings.

- 4) The transfer switch shall be installed per the NEC.
 - 5) The mounting of the transfer switch shall meet or exceed the seismic requirements for the jurisdiction installed.
- b. Field Quality Control
- 1) The local authority having jurisdiction shall approve the installation of the transfer switch and generator set before they are energized.
- c. Open Transition Sequence of Operation
- 1) Transfer switch normally connects an energized utility power source (source 1) to loads and a generator set (source 2) to loads when the normal source fails. The normal position of the transfer switch is source 1 (connected to utility) and no start signal is supplied to the generator.
 - 2) Generator set exercise test with load mode. The control system shall be configurable to test the generator set under load. In this mode the transfer switch shall control the generator set in the following sequence.
 - a) Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program or when manually initiated by the operator.
 - b) When the control system senses the generator set at rated voltage and frequency it shall operate to connect the loads to the generator set by opening the normal source contacts and closing the emergency source contacts at a predetermined time later. The timing sequence for the contact operation shall be programmable in the controller.
 - c) The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period the transfer switch shall automatically reconnect to the normal service.
 - d) On completion of the exercise period the transfer switch shall operate to connect the loads to the normal source by opening the emergency source contacts and closing the normal source contacts a predetermined time later. The timing sequence for the contact operation shall be programmable in the controller.
 - e) The transfer switch shall operate the generator set unloaded for a cool down period and then remove the start signal from the generator set. If the normal power fails at any time when the generator is running, the transfer switch shall immediately connect the system loads to the emergency source.
 - 3) Generator set exercise test without load mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode the transfer switch shall control the generator set in the following sequence.
 - a) Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program or when manually initiated by the operator.
 - b) The control system shall operate the generator set unloaded for the duration of the exercise period.

- c) At the completion of the exercise period the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator is running, the transfer switch shall immediately connect the system loads to the emergency source.
- d. Start-up and Testing
 - 1) An authorized employee of the manufacturer's service division shall perform the start-up and testing services.
 - 2) Provide a signed certificate stating the installation meets or exceed the manufacturer's installation standards and instructions.
 - 3) Verification that the transfer switch is operating as specified.
 - 4) Provide a printout of all as-commissioned adjustable set points for future reference.
- e. Demonstration and Training.
 - 1) An authorized employee of the manufacturer's service division shall perform the demonstration and training services. The demonstration and training period shall last a minimum of 4 hours and shall be provided on site.
 - 2) The OWNER reserves the right to video tape the demonstration and training presentation for future in-house use.
 - 3) Provide training handouts for 10 persons.

END OF SECTION

SECTION 16440 PANELBOARDS

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) This Section includes the requirements for panelboards, utility meter sockets and current transformer (CT) can.

1.2 REFERENCES

- a. The following is a list of Standards which may be referenced in this Section.
 - 1) National Fire Protection Association (NFPA).
 - a) 70 – National Electrical Code (NEC).
 - 2) National Electrical Contractors Association (NECA).
 - a) 5055 - National Electrical Installation Standards (NEIS).
 - 3) National Electrical Manufacturers Association (NEMA).
 - a) AB 1 – Molded Case Circuit Breakers.
 - b) KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 volts maximum).
 - c) PB 1 – Panelboards
 - d) PB 1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
 - 4) International Electrical Testing Association (NETA).
 - a) Acceptance Testing Specifications.
 - 5) Underwriters Laboratory, Inc. (UL).
 - a) 50 – Enclosures for Electrical Equipment.
 - b) 67 – Panelboards.
 - c) 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures.

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

- 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
 - d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.
 - 2) Manufacturer’s data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

1.4 QUALITY ASSURANCE

- a. Panelboards shall be manufactured in accordance with the Standards listed under 1.2 REFERENCES.

1.5 DELIVERY, STORAGE AND HANDLING

- a. Equipment shall be stored and installed in clean, dry and heated environment.

1.6 SELECTIVE COORDINATION REQUIREMENTS

- a. The manufacturer of the panelboard overcurrent protection devices has been designed to comply with the Selective Coordination requirements of the current edition Oregon Electrical Specialty Code. Alternate manufacturers shall be considered only under the following conditions:
 - 1) The Contractor shall provide a design of the entire NEC Article 700 Emergency distribution system to demonstrate compliance with the Selective Coordination requirements of the current edition of the Oregon Electrical Specialty Code.

- 2) The Contractor shall provide a scaled floorplans demonstrating that the size of the alternate electrical equipment does not exceed the space requirements of the basis of design.
- 3) The Contractor shall provide a written document stating that the alternate design complies with the Selective Coordination requirements of the current edition of the Oregon Electrical Specialty Code. The document shall be signed and stamped by a licensed Professional Electrical Engineer or Supervising Electrician in the State of Oregon.
- 4) Acceptance of the alternate shall require written approval by the Engineer.

PART 2: PRODUCTS

2.1 MANUFACTURED UNITS

- a. Branch Panelboards (16440.B01).
 - 1) Shall be rated as shown on the Drawings.
 - 2) Shall have a NEMA 1 enclosure, painted gray and surface mount unless shown otherwise on the Drawings. Enclosure shall not have pre-punched conduit knockouts.
 - 3) Front cover shall be provided with a door within a door configuration with continuous hinged doors that are lockable for both the inner access and the front door providing access to the circuit breakers. The dead front shall be attached to the access door such then when opened the dead front swings open with the door.
 - 4) Main breaker shall have an available in-rush current (AIC) rating as shown on the Drawings. Branch circuit breakers shall have the same rating unless specifically shown otherwise on the Drawings.
 - 5) Main breaker shall have an ampere rating as shown on the Drawings.
 - 6) Branch circuit breaker capacity shall be as shown on the Drawings. Provide branch circuit breakers as shown on the Drawings.
 - 7) Bus material shall be 100% copper rated for the voltage and ampere rating shown on the Drawings as a minimum.
 - 8) Grounded conductor connection means shall be isolated, copper.
 - 9) Grounding conductor connection means shall be copper.
 - 10) Breakers shall be bolt-on type. No half sized breakers shall be permitted.
 - 11) Provide two (2) 2-pole and two (2) single-pole locks for the branch circuit breakers.
 - 12) See the panel schedule in the Drawings for additional data.

- 13) Provide arc flash labels compliant with the NEC, OESC and OSHA.
 - 14) Where shown on the Drawings, provide integral, factory installed TVSS, IEEE C62.41 certified, 50kA per phase surge rating or higher. Coordinate voltage to match panel. Provide Eaton type SPD, or approved equal.
 - 15) Provide Eaton Series Pow-R-Line 1X, Pow-R-Line 2X, Pow-R-Line 3X, Siemens, Square D, or approved equal.
- b. Utility Meter Socket (16440.M15).
- 1) The meter socket shall comply with the specifications of the local electric utility servicing the project.
 - 2) The meter socket enclosure shall be gray, painted steel.
- c. Current Transformer (CT) Can (16440.C15).
- 1) The CT Can shall comply with the specifications of the local electric utility servicing the project.
 - 2) The meter socket enclosure shall be gray, painted steel.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General.
- 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
 - 2) Panels shall be grounded and bonded as shown on the Drawings and per the NEC whichever is more stringent.
 - 3) Conductors shall be neatly grouped and routed within the enclosures.
 - 4) Used and spare conductors shall be clearly identified as specified in Section 16121.
 - 5) The utility meter socket and CT can shall be installed per the utilities specifications.
 - 6) Due to the number of conduits entering the panelboards it will be imperative that the CONTRACTOR plan the layout carefully so all the conduits fit in the bottom of the panelboards. Should a gutter be necessary, it shall be no deeper than the panelboards and only as wide as necessary to accommodate the conduits.
 - 7) Provide typed circuit directory for each panelboard.
 - 8) Install nameplates as shown on the Drawings and specified in Section 16050.

END OF SECTION

SECTION 16447
LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes
 - 1) This section includes requirements for Low voltage (600 VAC or less) Motor Control Centers (MCC).
- b. The Motor Control Centers listed on this project are OWNER Furnished, CONTRACTOR Installed (OFCI).
 - 1) Blower Building MCC: MCC-2000 is furnished by the SBR System Supplier and shall be installed by the CONTRACTOR.
 - 2) DAF Building MCC: MCC-3000 is furnished by the OWNER's System Integrator (OSI) and shall be installed by the CONTRACTOR.
- c. The CONTRACTOR shall coordinate with the OWNER, the OWNER's System Integrator, and the SBR System Supplier for delivery, storage, handling, and installation of the MCCs at the locations identified on the Drawings.

1.2 REFERENCES

- a. The following is a list of Standards that may be referenced in the Section.
 - 1) NEMA Standard ICS-2 Industrial Control and System Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - 2) Underwriters Laboratories (UL) Standard No. UL-508C Power Conversion Equipment.
 - 3) Underwriters Laboratories (UL) Standard No. UL-845 Motor Control Centers.
 - 4) American National Standards Institute ANSI C19.3 Compressors for Process Industries.
 - 5) National Electric Code (NEC).
- b. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.3 DELIVERY, STORAGE, AND HANDLING

- a. Equipment Handling

- 1) 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.

1.4 COMMISSIONING

- 1) Provide commissioning in accordance with Section 16001.

PART 2: PRODUCTS

2.1 MOTOR CONTROL CENTERS

- a. The Motor Control Centers listed on this project are OWNER Furnished, CONTRACTOR installed (OFCI).
- b. The CONTRACTOR shall coordinate with the OWNER and the OWNER's System Integrator to install the MCCs at the locations identified on the Drawings

2.2 SEISMIC BRACING

- a. Provide seismic bracing for the Motor Control Centers required by the International Building Code and Oregon Structural Specialty Code.
- b. The design of the seismic anchoring and bracing system shall be by a licensed Structural Engineer in the State of Oregon. The CONTRACTOR shall arrange and pay for the services of the licensed Engineer.
- c. Wet stamped and signed calculations and drawing of the seismic anchoring and bracing system shall be submitted to the Engineer for review and approval
- d. Include Manufacturer's seismic certificate.

PART 3: EXECUTION

3.1 INSTALLATION

- a. All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
- b. Motor control center floor sills shall be bolted directly to a concrete equipment pad. The equipment pad shall be 4" high with a minimum 2" reveal on each side of the switchboard enclosure.
- c. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed.
- d. In general, all conduits entering or leaving a motor control center or switchboard shall be stubbed into the bottom or top horizontal wireway directly below or above the vertical section in which the conductors are to be terminated.

- e. Housekeeping pads shall be included for the motor control centers or switchboards as detailed in the Contract Documents.
- f. Install the equipment in accordance with the manufacturer's instructions. TVSS installation shall be integrated into the MCC lineup with leads close coupled to busses to limit transient voltages as recommended by the manufacturer.
- g. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.
- h. Make wiring interconnections between shipping splits.
- i. Install bus splice plates and torque connections.
- j. Seal all seams, cracks, or openings.

3.2 START-UP AND TESTING

- a. The CONTRACTOR shall provide labor to support the manufacturer's on-site start-up and testing services, including, but not limited to, energizing and de-energizing equipment, lockout/tagout, opening/closing enclosures, measuring voltages and continuity, starting and stopping motors and equipment, and all other tasks required to support the start-up and testing services. The requirements for manufacturer's start-up and testing services may be obtained from the OWNER as part of the OWNER furnished, CONTRACTOR installed specifications. The requirements can be obtained from the OWNER.

3.3 FIELD QUALITY CONTROL

- a. The CONTRACTOR shall have complete responsibility for field quality control. This includes the following responsibilities:
 - 1) Coordinate MCC installation and testing with other equipment installation and testing per Section 16080.
 - 2) Ensure protection of the equipment from damage during construction. This includes the provision of adequate on site storage facilities prior to installation.
 - 3) Ensure that the area of installation is fully prepared according to the Contract Documents prior to the commencement of the MCC installation.
- 1. Provide complete and accurate as-built schematic drawings.
- b. Site Tests, Inspection
 - 1) In accordance with Section 16080.

3.4 CLEANING

- a. After testing is complete, the CONTRACTOR shall inspect and clean the MCC equipment and remove any material introduced during the testing and/ or left from the

initial installation. Remove all rubbish and debris from inside and around the control center. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION

SECTION 16460
LOW VOLTAGE DRY TYPE TRANSFORMERS

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) This Section includes the requirements for low voltage dry type transformers and their installation.

1.2 REFERENCES

- a. The following is a list of Standards which may be referenced in this Section.
 - 1) American National Standards Institute (ANSI).
 - a) C57.12.50 and C89.1 Ventilated Dry Type Power Distribution Transformers.
 - 2) National Fire Protection Association (NFPA).
 - a) 70 – National Electrical Code (NEC).
 - 3) National Electrical Manufacturers Association (NEMA).
 - a) ST.20 – Dry Type Transformers for General Application.
 - 4) Underwriters Laboratory, Inc (UL).
 - a) 506 – UL Standard for Safety for Specialty Transformers.

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not

clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

- 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.
 - 2) Manufacturer’s data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.
 - 3) Manufacturer’s data including outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, impedance ratings, tap configurations, insulation type and temperature rise.

1.4 DELIVERY, STORAGE AND HANDLING

- a. Acceptance at Site.
 - 1) Verify nameplate data meets the specified requirements.
 - 2) Store in a clean, dry space.
- b. Storage and Protection.
 - 1) Handle in accordance with the manufacturer’s written instructions.
 - 2) Lift only with lugs provided.
 - 3) Handle carefully to avoid damage to transformers internal components, enclosure and finish.

PART 2: PRODUCTS

2.1 MANUFACTURED UNITS

- a. Transformer (16460.T01).
 - 1) Product description: DOE 2016, factory assembled, air-cooled, dry type transformers, ratings as shown on the Drawings.
 - 2) Unit kVA and voltage shall be as shown on the Drawings.

- 3) Insulation system and average winding temperature rise for rated KVA shall be Class 220 with a 115 degree C rise.
- 4) Case temperature shall not exceed 30 degrees C rise above ambient temperature at warmest point at full load.
- 5) Sound level shall meet NEMA ST 20 Standard.
- 6) Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- 7) Units up to and including 112.5 KVA shall be suitable for wall or floor mounting.
- 8) Coil conductors shall be continuous copper windings with terminations brazed or welded.
- 9) Enclosure shall be NEMA 1 type unless specifically called out differently on the Drawings.
- 10) Cooling shall be factory assembled air cooled type.
- 11) Isolate core and coil from enclosure using vibration-absorbing mounts.
- 12) Terminations shall be suitable for termination copper conductors without any special modifications.
- 13) Nameplate shall include transformer connection data and overload capacity based on rated allowable temperature rise.
- 14) The basis of design is for the manufacture specified. Any modifications to the design that may become necessary due to the approval of an "or equal" product shall be the responsibility of the CONTRACTOR.
- 15) Provide factory-installed noise and vibration isolation. The noise and vibration isolation shall consist of the following:
 - a) Isolation bushings on transformer core for vibration isolation.
 - b) Insulation on the interior of the enclosure of noise isolation.
 - c) Vibration isolation feet.
 - d) Rubber isolation pads shall be provided.
- 16) Provide Eaton model number DT-3, Siemens, Square D, or approved equal.

2.2 SEISMIC Certification

- a. Seismic Bracing Certification (16460.S01).
 - 1) The Manufacturer shall provide a seismic certificate.
 - 2) Contractor shall provide seismic anchor bolts for all transformers shown on the Drawings.

- 3) The seismic anchor bolts shall be designed by a licensed Structural Engineer in the State of Oregon. The Structural Engineer shall provide wet stamped and signed seismic calculations and drawings.
- 4) The seismic anchor bolt design shall comply with the Manufacturer's seismic requirements.
- 5) The Contractor shall provide transformer approved shop drawings to the Structural Engineer. The shop drawings shall indicate the weight and dimensions of the transformer. The Contractor shall provide any additional information required by the Structural Engineer to perform the seismic calculations.

2.3 ACCESSORIES

- a. Transformer Isolation Pads (16460.P20).
 - 1) Provide rubber isolation pads under the transformer at each anchor point. The product used shall be manufactured specifically for this purpose.
 - 2) The pads shall be 1.0 inch thick minimum.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General.
 - 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
 - 2) The wall bracket shall be anchored as recommended by the manufacturer and as shown on the Drawings, whichever is more stringent. The mounting shall be designed to withstand a seismic zone 4 event.
 - 3) The transformer shall be connected to the grounding electrode system and treated as a separately derived system.
 - 4) The transformer shall be set level and plumb.
 - 5) Mount the transformer on isolation pads with a pad located at each anchor point.
 - 6) Line and load conduits shall include a minimum of two (2) feet of LFAC flexible conduit.

END OF SECTION

SECTION 16511 INTERIOR LUMINAIRES

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) This Section includes the requirements for the interior illumination fixtures and controls.

1.2 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.

- 2) Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

1.3 QUALITY ASSURANCE

- a. Regulatory Requirements.
 - 1) All products shall be UL listed for the environment they are installed in.

PART 2: PRODUCTS

2.1 FIXTURES

- a. As shown on the Luminaire Fixture Schedule on the Drawings.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General.
 - 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
 - 2) CONTRACTOR shall provide all mounting hardware required to mount luminaires in lay-in or gypsum board ceilings. Verify ceiling types with the ARCHITECT. Luminaires of a given type may be used in more than one type of ceiling.
 - 3) Luminaires shall be supported by #12 AWG hanger wire connected to the luminaire and the building structure.
 - 4) Positively attach all luminaires to the suspended ceiling system. Attachment devices shall have capacity of 100% of the luminaire weight acting in any direction.
 - 5) Verify luminaire locations with the ARCHITECT'S reflected ceiling plan.
 - 6) Adjustable luminaire heads shall be aimed as directed by the ENGINEER.
 - 7) All luminaires shall be cleaned of all dirt, dust, and finger prints prior to close-out.
 - 8) Luminaries I02; shall be mounted to the wall such that the top of the fixture is six (6) inches below the ceiling or 9'-0" AFF, whichever is less. Use anchors specified in Section 16070.
 - 9) Luminaries I03; shall be mounted to the wall such that the top of the fixture is six (6) inches below the ceiling or 9'-0" AFF, whichever is less. Use anchors specified in Section 16070.

END OF SECTION

SECTION 16512
EXTERIOR LUMINAIRES

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) This Section includes the requirements for exterior illumination fixtures and control.

1.2 SUBMITTAL

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.

- 2) Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

1.3 QUALITY ASSURANCE

- a. Regulatory requirements.
 - 1) Products provided shall be UL listed for the environment in which they are installed.

PART 2: PRODUCTS

2.1 FIXTURES

- a. As shown on the Luminaire Fixture Schedule on the Drawings.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General.
 - 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
 - 2) Fixtures mounted above doors shall be centered unless specifically called out otherwise on the Drawings.
 - 3) Fixtures mounted on the exterior of split face block shall be fed with a conduit entering the back of the fixture routed from the interior of the building. Mounting the fixture on a box is unacceptable.
 - 4) Use stainless steel mounting hardware.
 - 5) Mount at the height shown on the Drawings.
 - 6) Fixtures mounted on the building shall have a photo electric control with a manual toggle switch override unless shown differently on the drawings.
- b. Light Poles.
 - 1) Shall be mounted level and plumb.
 - 2) Shall be installed per the detailed Drawing. Provide the rebar, anchor bolts and 3000 PSI concrete for the pole bases.
 - 3) Light fixture heads shall be oriented as shown on the Drawings.
 - 4) Using non-shrink grout, the CONTRACTOR shall grout smooth all exposed areas of the concrete pole base, filling all air pockets and irregularities.

c. Photo Electric Switch.

- 1) Externally mounted photo electric switches shall be oriented north if at all possible.
- 2) Shall be oriented away from artificial light sources.

END OF SECTION

SECTION 16746
MULTI MODE FIBER OPTIC CABLE SYSTEMS

PART 1: GENERAL

1.1 SUMMARY

- a. Section Includes.
 - 1) The Section includes the requirements for fiber optic cable, connectors, enclosures and related materials.

1.2 REFERENCES

- a. General
 - 1) The current editions of the publications listed below form a part of this Section.
 - 2) American National Standards Institute (ANSI).
 - a) ANSI; C8.47; American national standard for polyolefin-insulated thermoplastic jacketed communication cables.
 - 3) Electronics Industry Association (EIA).
 - a) EIA-455 – Standard fiber optic test procedures (FOTP's) devices.
 - b) EIA-598A – Standard colors for identification and coding.
 - c) EIA-568B.1 – Commercial building telecommunications cabling standard; general requirements.
 - d) EIA-568B.3 – Commercial building telecommunications cabling standard; optical fiber cabling components.
 - e) EIA-606 – Administration Standard for telecommunications infrastructures of commercial buildings.
 - f) EIA-TSB140 – Additional guidelines for field testing length, loss and polarity of optical fiber cabling systems.
 - g) EIA-526-14A (OFSTP) – Optical power loss measurement of installed multimode fiber cable plant.
 - h) EIA-526-7 (OFSTP) – Measurement of optical power loss of installed single mode fiber cable plant.
 - 4) Insulated Cable Engineers Association (ICEA).
 - a) ICEA-5-83-696 – Fiber optic premises distribution cable (indoor/outdoor).
 - 5) International Organization for Standardization/International Electrotechnical Commission (ISO/IEC).
 - a) ISO/IEC 11801 Ed.2:2002 – Information Technology; generic cabling for customer premises.
 - 6) National Electrical Manufacturers Association (NEMA).
 - a) NEMA-TC-2 – Conduit.
 - b) NEMA-TC-3 – Accessories.

- 7) National Fire Protection Association (NFPA).
 - a) NFPA-70 – National Electrical Code (NEC); Article 770 – Optical fiber cables and raceways.
- 8) Underwriters Laboratory (UL).
 - a) UL-514 – Accessories.
 - b) UL-651 – Conduit.
 - c) UL-910 – Plenum Cable.
 - d) UL-1666 – Riser Cable.

1.3 SUBMITTALS

- a. Contractor shall submit all the product data in Division 16 at the same time. Piecemeal submittals will be rejected as incomplete.
- b. Submittal Format:
 - 1) The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
 - 2) A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.
 - 3) No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.
 - 4) Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.
- c. Refer to Section 16050 – Common Work Results for Electrical Submittals for additional requirements.
- d. Product Data
 - 1) Pursuant to Section 01300 – Submittal Procedures.
 - 2) Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

- 3) Detailed Bill Of Materials (BOM) for fiber optic cable, terminations, patch cables, fiber optic enclosures and accessories.

1.4 DELIVERY, STORAGE AND HANDLING

- a. The cable shall be packaged at the factory wound on spools or reels. Each spool shall contain only one single continuous length of fiber optic cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.
- b. It is the CONTRACTOR's responsibility to determine all required cable lengths.
- c. Both ends of the cable shall be accessible for testing after being placed on the reel the ends shall be sealed.

PART 2: PRODUCTS

2.1 FIBER OPTIC CABLE CHARACTERISTICS

- a. Fiber Optic Cable, Loose-Tube Gel Free (16745.F01).
 - 1) Fiber optic cable shall be multi mode.
 - 2) Fiber optic cable shall be loose-tube, gel-free, all-dielectric, indoor/outdoor rated, riser rated (OFNR), suitable for direct-burial, aerial, and duct applications. Cable shall be UV stabilized and fully water blocked. Jacket shall be black polyurethane, flame-retardant and UV-resistant.
 - 3) Fiber optic cable category shall be multi mode OM4.
 - 4) Fiber optic cable shall be compliant with ANSI/ICEA S-87-640 Design and Test Criteria.
 - 5) Fiber optic cable shall be rated for installation and operation in temperature ranges between -30 degrees C and 70 degrees C.
 - 6) Fiber optic cable shall be free of hazardous substances according to RoHS 2002/95/EG.
 - 7) Fiber count shall be 12-strand.
 - 8) Fiber core diameter shall be 8.2 micrometers.
 - 9) Fiber shall be capable of operating at wavelengths of 1310 nanometers, 1383 nanometers, and 1550 nanometers.
 - 10) Fiber maximum attenuation shall be 0.4 dB/km at 1310 nm, 0.4 dB/km at 1383 nm, and 0.3 dB/km at 1550 nm.
 - 11) The cable shall contain at least one ripcord under the sheath for easy sheath removal.

- 12) Fiber optic cable shall contain a water-swellaable tape between then outer jacket and the inner filling and buffer tubes.
- 13) The jacket or sheath shall be free of holes, splits and blisters. The cable jacket shall contain no metal elements and shall be of a consistent thickness. Cable jackets shall be marked with manufacturer's name, sequential meter or foot markings, the year of manufacture and a telecommunications handset symbol as required by Section 350G of the National Electrical Safety Code (NESC). The actual length of the cable shall be within 1 % of the length markings. The markings shall be in contrasting color with the cable jacket. The height of the markings shall be approximately 2.5 mm
- 14) Fiber optic cable shall be Corning ALTOS Loose Tube, Gel-Free Cable, or approved equal.

2.2 FIBER OPTIC CABLE TERMINATIONS, CONNECTORS AND CABLE ASSEMBLIES.

a. Fiber Optic Splice Closure (16745.B44).

- 1) Individual fibers within a loose tube cable with coated fibers shall use a splice closure to maintain flexibility and ease of handling fibers within a fiber optic vault. Splice closures shall be installed in the fiber optic vaults where splices are required. The optical splice loss shall comply with the specifications for optical splices. Splice protection sleeves shall be employed on all splices to protect the splices. All fibers shall be provided with connectors and tested.
- 2) Splice closures shall be provided where indicated on the Drawings.
- 3) Splice closures shall be fully sealed, canister-style construction, rated for indoor and outdoor use, and suitable for both duct and direct buried applications.
- 4) Splice closures shall be provided with splice trays with a capacity of 12 single fibers.
- 5) Splice closures shall be provided with a slack storage basket and tray stacker.
- 6) Splice closures shall be provided with five ports; three ports for drops and two ports for feeders.
- 7) Splice closures shall be 4 inches in diameter and 18 inches in length.
- 8) Splice closures shall be wall mountable.
- 9) Splice tray shall be Corning SCF series, or approved equal.

b. Fiber Optic Connectors (16745.C39).

- 1) All cable assemblies shall have LC type connectors installed. The connectors shall provide tight fitting termination to the cladding and buffer coating. Epoxy-based or "hot melt" adhesives shall be used to bond fiber and buffer to the connector ferrule and body prior to polishing the endface.

- 2) After termination with connectors, the fiber ends shall be visually inspected at a magnification of no less than 100 power for multimode and 200 power for single mode to check for cracks or pits in the endface of the fiber.
 - 3) Connectors shall have a maximum allowable connection loss of 0.75 dB per mated pair as measured per EIA-455-34. No index matching gel is to be used, dry interfaces only.
 - 4) Each connector shall be of the industry standard LC type compatible, designed for single mode and multimode tolerances and shall meet or exceed the applicable provisions of EIA-455-5, 455-2A and 455-34 and shall be capable of 100 repeated ratings with a maximum loss increase of 0.1 dB. Connectors shall incorporate a key-way design and shall have a sirconia ceramic ferrule. Connector bodies and couplings shall be made of corrosion-resistant and oxidation-resistant materials such as nickel plated zinc, designed to operate in humid environments without degradation of surface finishes.
 - 5) Connectors shall be Corning, or approved equal.
- c. Fiber Optic Patch Cables (16745.P89).
- 1) Fiber optic patch cables shall be installed between Fiber Optic Patch Panels and Fiber to Ethernet Managed Network Switches in control panels.
 - 2) Fiber optic patch cables shall be single mode OM4 type, LC to LC duplex style.
 - 3) Fiber optic patch cable shall be 1 meter long.
 - 4) Typical dB loss shall be 0.25 dB per connection.
 - 5) Provide two (2) spare fiber optic patch cables for fiber optic patch panel. Place the spares in the control panel neatly coiled and labeled as spares.
 - 6) Patch cables shall be Panduit F9E10-10M1Y, or approved equal.

PART 3: EXECUTION

3.1 INSTALLATION

- a. General.
- 1) All identification labeling shall be in compliance with Section 16075 Electrical and Control Identification.
 - 2) The CONTRACTOR is responsible to select a cable installation method which will ensure that all cable installation requirements are met. All work shall be carried out in accordance and consistent with the highest standards of quality and craftsmanship in the communication industry with regard to the electrical and mechanical integrity of the connections; the finished appearance of the installation; as well as the accuracy and completeness of the documentation.

- 3) The CONTRACTOR shall make a physical survey of the project site for the purpose of establishing the exact cable routing, cutting lengths, and vault locations prior to the commencement of any work or committing any materials. The site survey shall be conducted with the ENGINEER to identify exact locations and elevations of vaults and conduit routing.
- 4) The cable shall be carefully inspected for jacket defects as it is removed from the reel. If defects are encountered, the pulling operation shall be terminated immediately and the ENGINEER notified.
- 5) Fiber optic cables shall be installed in continuous lengths without intermediate splices throughout the project. Cable installation personnel shall be familiar with the manufacturer's recommended procedures including, but not limited to the following:
 - a) Proper attachment to the cable strength elements for pulling during installation. Depending on cable design, this will involve direct attachment to internal strength members or attaching an external "Kellums" or split mesh grip using a 600 lb. breakaway swivel.
 - b) Cable tension limitations and tension monitoring procedures.
 - c) Cable bending radius limitations.
 - d) Lubrication: As the cable is pulled into the raceway system, it shall be sufficiently lubricated with a lubricant which is a water-based type and approved by the cable manufacturer. Lubrication shall be applied at a rate to provide continuous 10-mil coating as recommended by the manufacturer.
 - e) Under no conditions shall the fiber optic cable be left exposed or unattended
 - f) Repairs: Repairs of the cable jacket shall not be permitted. Jacket damage shall require removal and reinstallation of a new cable run at the CONTRACTOR's expense.
- 6) Requirements for installation vaults
 - a) The pulling of the cable shall be hand assisted at each vault. The cable shall not be crushed, kinked or forced around a sharp (small radius) corner.
 - b) The cable shall be looped in all vaults to provide one hundred (100) feet of slack cable in the vault. The fiber optic cable shall be coiled and secured with cable ties in vaults. The cable shall be looped around the vault on the support arms with appropriately sized cable ties. The CONTRACTOR shall ensure that the minimum bending radius of the fiber optic cable is not compromised when preparing this stored cable slack.
- 7) Requirements for installation at Splice Closures
 - a) The cable shall not be crushed, kinked or forced around a sharp (small radius) corner.
 - b) At fiber optic splice closures fifteen (15) feet of cable, or as much as the splice closure can accommodate, shall be looped to facilitate future re-terminations as may be required.

- c) The CONTRACTOR shall ensure that the minimum bending radius of the fiber optic cable is not compromised when preparing this stored cable slack.
 - d) Not all pairs of fiber in fiber optic cable are spliced and continue beyond the splice closure. All unused fiber shall be coiled in the splice closure and labeled as spare. Refer to the Drawings for quantity of spare fibers.
- 8) Requirements for installation at Control Panels
 - a) The cable shall not be crushed, kinked or forced around a sharp (small radius) corner.
 - b) At fiber optic splice closures fifteen (15) feet of cable, or as much as the control panel can accommodate, shall be looped to facilitate future re-terminations as may be required.
 - c) Utilize fiber optic bend radius control fins to coil slack fiber and maintain minimum bending radii.
 - d) The CONTRACTOR shall ensure that the minimum bending radius of the fiber optic cable is not compromised when preparing this stored cable slack.
- 9) Splicing.
 - a) Splicing of fiber optic cable at any point other than the termination cabinets identified on the Drawings shall not be permitted.
 - b) Fibers shall be spliced using fusion splicing only. Mechanical splicing methods shall not be acceptable.
 - c) Utilize cleavers, fusion splicing machines, and stripping tools which are approved by the manufacturer.
 - d) Bare fibers shall be cleaned using isopropyl alcohol wipes after stripping.
 - e) Cleaves shall be straight. Jagged and non-uniform cleaves shall not be acceptable.
 - f) Splice dB loss shall not exceed 0.3 dB. Any splice with a dB loss greater than 0.3 dB shall not be acceptable.

3.2 FIELD QUALITY CONTROL

- a. The CONTRACTOR shall perform pre-installation and post installation Fiber Optic Cable (FOC) tests. Tests shall include end-to-end attenuation and Optical Time Domain Reflectometer (OTDR) for quantitative measuring. The ENGINEER shall be notified no less than ten (10) days in advance of the testing which the ENGINEER shall witness. All test equipment shall be traceable to the National Institute of Standards and Technology (NIST) standards. Testing methods, instruments and documents shall conform to the Standards listed herein.
 - 1) The CONTRACTOR shall use the following to perform pre-installation and post-installation FOC tests:
 - a) Optical time domain reflectometer (OTDR). The OTDR shall be laser precision and be able to test single mode or multimode systems with a visual fault locator. The OTDR shall be a multi-tester with the ability to integrate a power meter, source and visual fault locator. The OTDR shall also include a disk drive and hard drive for storing test data.

- b) Provide a companion PC software package for analysis, comparison and printing saved test data.
 - c) Patch cables and interface adapters shall be included in the testing.
- 2) Pre-installation test with FOC still on the reel shall be performed as specified below:
- a) The purpose of these tests is to perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specification, is free from defects, breaks and damages by transportation and manufacturing process and to provide a baseline dB reading.
 - b) Prior to removal of each cable from the delivery reel, all optical fibers within the cables shall be tested by the CONTRACTOR using an OTDR. The OTDR tests shall consist of end-to-end length and fiber attenuation (dB/km) measurements to ensure proper performance of the fiber optic cable. The tests shall be performed from both ends of each fiber to ensure complete fiber continuity within the cable structure.
 - c) Pre-installation, "on-reel" test results shall be compared with the manufacturer's test report delivered with the cable. Gross dissimilarities shall be noted and remedied between the CONTRACTOR and manufacturer. In all cases, all fibers shall meet the optical attenuation specifications prior to cable installations.
 - d) The CONTRACTOR shall perform tests on all reels of cable. The ENGINEER shall be notified no less than ten (10) days in advance of any test.
 - e) The CONTRACTOR shall document each test and submit the report to the ENGINEER for approval. The submittal shall be in hard copy form. Electronic copy shall not be permitted.
 - f) The cable shall not be installed prior to submittal, review and approval of the pre-installation test documentation.
 - g) Maximum allowable attenuation is 0.5 dB/km at 1310 nm. The CONTRACTOR shall replace any cable in which any fiber fails to meet these standards.
- 3) Post-installation tests after the FOC has been installed and terminated shall be performed as specified below:
- a) A recording OTDR shall be used to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall have an X-Y plotter to provide a hard copy record of each trace of fiber. The OTDR shall be equipped with sufficient internal masking to allow the entire cable section to be tested. This may be achieved by using an optical fiber pigtail of 30 feet or more to display the required cable section.
 - b) Maximum allowable attenuation is 0.5 dB/km at 1310 nm. The CONTRACTOR shall replace any cable in which any fiber fails to meet these standards.
 - c) The OTDR shall be calibrated for correct index refraction to provide proper length measurement for the known length of referenced fiber.
 - d) A transmission test shall be performed with the use of an 1310 nm stabilized light source and 1310 nm power meters for singlemode fiber.

This test shall be conducted in both directions on each fiber for each cable.

- e) Hard copy test documentation of test documentation shall be submitted to the ENGINEER. The documentation shall include the trace plot, index, dB/km loss, cable length, date and time of test, wavelength, pulse width, test site, cable identification, fiber number and type and initials of the person supervising the tests. The CONTRACTOR shall compare the pre-installation test results to the post-installation results. If there is a deviation equal to or greater than one (1) dB, the ENGINEER shall be notified in writing by the CONTRACTOR and the cable shall be removed and replaced at no additional cost to the OWNER.
 - f) Upon completion of the tests all FOC coils shall be secured and end caps installed and secured to prevent intrusion of dirt and water.
- 4) Required OTDR Trace Information:
- a) All traces shall display the entire length of cable under test, highlighting any localized loss discontinuities (installation induced losses and/or connector losses). The trace shall display fiber length (in kilometers), fiber loss (dB) and average fiber attenuation (in dB/km) as measured between two markers placed as near to the opposite ends of the fiber under test as possible while still allowing an accurate reading. Care shall be taken to ensure that the markers are placed in the linear region of the trace; away from the front end response and far end Fresnel reflection spike. Time averaging shall be used to improve the display signal to noise ratio. The pulse width of the OTDR shall be set to a sufficient width to provide adequate injected power to measure the entire length of the fiber under test.
 - b) Two traces shall be recorded. One trace shall be the fiber loss (dB) and average attenuation (dB/km) of the entire cable segment under test including the connectors. The second trace shall display a magnified view of the connector regions revealing the connector losses (dB). All connector losses shall be measured using the 5-point splice loss measurement technique.
 - c) The date and time of the test.
 - d) The cable identification number.
 - e) The cable segment number.
 - f) The fiber color or sub-cable number.
 - g) The optical wavelength used for the test.
 - h) The reflective index setting of the OTDR.
 - i) The pulse width setting of the OTDR.
 - j) The averaging interval of the test.
- 5) The CONTRACTOR shall submit a certification of compliance of the pre- and post installation test completion to the ENGINEER.

END OF SECTION