The Tulalip Tribes of Washington

MBR Treatment Facility Upgrade

Bid Solicitation No. 17-004

Contract Documents
Divisions 26 through 46 and
Appendices A through D

February 2018

Volume 2 of 3

MBR TREATMENT FACILITY UPGRADE

Bid Solicitation No. 17-004

Contract Documents

Prepared for

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CITATION

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Contract Documents
Prepared by Parametrix, Puyallup, Washington.
February 2018.

CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

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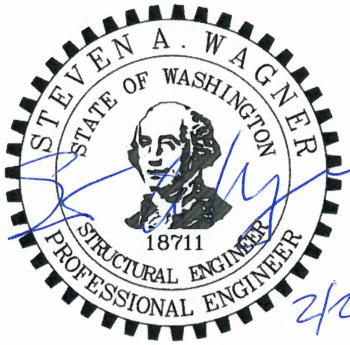

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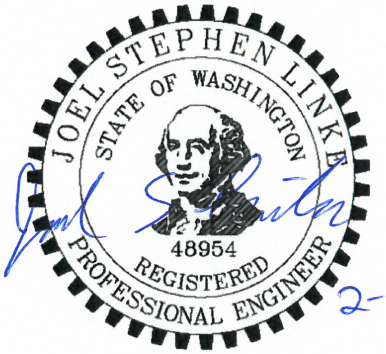

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Division 26

Electrical

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Provide electrical materials and labor to satisfactorily complete electrical work shown on the Drawings, specified, or neither shown nor specified but necessary for a complete and fully operating facility.

B. Mounting details of equipment, devices, light fixtures, raceways, junction boxes, etc., are not usually shown or specified, provide per industry standard practice and code requirements as necessary for proper installation and operation. This work shall be included in the Contractor's estimate, the same as if specified or shown.

1.02 RELATED SECTIONS

A. The work of all sections within Division 26, "Electrical", and Division 40, "Process Interconnections", is related to the work of this section. Other sections may also be related to the proper performance of this work. It is the Contractor's responsibility to perform all the work required by the Contract Documents.

1.03 SUBMITTALS

A. Procedures: See Division 01, "General Requirements".

B. Submittal package shall be organized by equipment type:

1. Include separators and tabs or other means of identifying each item.

C. Shop Drawings: Show dimensions, physical configurations, methods of connecting equipment, mounting details, wiring schematics, etc.:

1. Drawings shall be complete with device numbers, wire numbers, and terminal board numbers.

D. Submit fabrication details and nameplate legends:

1. Include material lists and/or bills of material.

E. Catalog Cut Sheets: Show model numbers, product technical specifications, ratings, range, weight, accuracy, diagrams, application information, etc.:

1. Manufacturers' catalog cuts, specifications, or data sheets shall be clearly marked to delineate the options or styles to be furnished.

F. Bill of Material (BOM): BOM shall include equipment item number, quantity, manufacturer, part number, model number, and descriptions.

G. Nameplate schedule.

H. Qualifications of testing organization and personnel meeting requirements of ATS-2017, Section 3.

I. Inspection and acceptance testing reports per ATS-2017, Paragraph 5.4, or MTS-2015, Paragraph 5.4 for equipment for which tests are required in this and other Division 26 sections.

J. Field test results specified in Part 3 of this section.

K. Operation and Maintenance manuals in compliance with Division 01, “General Requirements”.

L. Spare Parts: For each piece of equipment, submit a list of recommended spare parts. Include part numbers and the name, address, and telephone number of the supplier.

M. Record Drawings:

1. Contract Drawings: Upon completion of the work, transfer the Contractor maintained As-Built Drawings to a clean set of full-size Drawings with red ink to indicate additions and green ink to indicate deletions:

   a. Submit these full-size Drawing markups to the Engineer and copy to the Owner.

2. Equipment Manufacturer Shop Drawings: Upon completion of the work, submit the As-Built Drawings from the equipment manufacturer with any modifications performed in the field:

   a. Submit these Drawings in both an Adobe Acrobat [*.PDF] format and an Autodesk AutoCAD [*.DWG] format.

1.04 QUALITY ASSURANCE

A. Variances: In instances where two or more codes are at variance, the most restrictive requirements shall apply.

B. Standards: Equipment shall conform to applicable standards of American National Standards Institute (ANSI), Electronics Industries Association (EIA), Institute of Electrical and Electronics Engineers (IEEE), and National Electrical Manufacturers Association (NEMA):

1. The revisions of these standards in effect on the date of issuance of the Contract Documents shall apply.

C. Electrical equipment, materials, and installation methods shall conform to applicable local and state codes as well as the editions of the following in effect on the date of issuance of the Contract Documents:

1. National Electrical Code (NEC).

2. National Electrical Safety Code (NESC).

3. National Electrical Contractors Association (NECA).

D. Electrical equipment must be listed or labeled by a Nationally Recognized Testing Laboratory (NRTL) for which an NRTL acceptance listing or labeling exists. An NRTL is recognized by Occupational Safety and Health Administration (OSHA) as being capable of independently assessing equipment for compliance to safety requirements and applicable standards. UL is an example of an NRTL.

E. Provide equipment with service entrance labels in those cases where the NEC requires such labels.

F. Series short circuit ratings for protective devices are not allowed.

G. Acceptance testing, studies, and reports per ATS-2017 or MTS-2015 for equipment for which tests are required in this and other Division 26 sections:

1. Testing organization and personnel performing tests shall meet the qualifications of ATS-2017, Section 3; MTS-2015, Section 3; and be certified per ANSI/NETA ETT-2015, Standard for Certification of Electrical Testing Technicians.

1.05 DRAWINGS

A. The Electrical Drawings are diagrammatic; exact locations of products shall be verified with the Engineer prior to installation. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this and other Division 26 sections shall take precedence in the event of conflict.

B. Field-verify scaled dimensions on Drawings.

C. Review the Drawings and specification divisions of other trades and perform the electrical work that will be required for the installations.

D. Submit in writing to the Engineer details of any proposed changes in or departures from these Contract Documents along with the explanations for the changes:

1. Make no changes or departures without the prior written favorable review of the Engineer.

E. Maintain a set of As-Built Drawings on-site that document/redline changes made to both the Contract Drawings and approved equipment manufacturer Shop Drawings.

1.06 JOB CONDITIONS

A. Operations:

1. Keep power shutdown periods to a minimum.

2. Carry out shutdowns only after the schedule has been favorably reviewed by the Owner and coordinated with the operations personnel.

B. Construction Power:

1. Contractor shall make arrangements for the required construction power.

2. When required, provide equipment, materials, and wiring in accordance with the applicable codes and regulations.

3. Upon completion of the project, remove temporary construction power equipment, material, and wiring from the site as the property of the Contractor.

C. Storage: Provide conditioned storage for equipment and materials per manufacturer's requirements that will become part of the completed facility so that it is protected from weather, dust, water, or construction operations.

1.07 DAMAGED PRODUCTS

A. Notify the Engineer in writing in the event that any equipment or material is damaged.

B. Obtain approval by the Owner and prior favorable review by the Engineer before making repairs to damaged products.

1.08 MATERIALS

A. Provide first quality, new materials, free from defects, and suitable for the intended use and space.

B. Where two or more units of the same class of material are required, provide products of a single manufacturer.

C. Unless otherwise indicated, provide materials and equipment that are the standard products of manufacturers regularly engaged in the production of such materials and equipment.

1. Provide the manufacturer's latest standard design that conforms to these Specifications.

1.09 LOCATIONS

A. General: Use equipment, materials, and wiring methods suitable for the types of locations in which they are located, as defined in Paragraph B herein.

B. Definitions of Types of Locations:

1. Dry Locations: Indoor areas which do not fall within the definitions below for Wet, Damp, Hazardous, or Corrosive Locations and that are not otherwise designated on the Drawings.

2. Wet Locations: Locations exposed to the weather, whether under a roof or not, or designated as Wet Locations by applicable codes and regulations, unless otherwise designated on the Drawings.

3. Damp Locations: Location wholly or partially underground, or having a wall or ceiling forming part of a channel or tank, or designated as Damp Locations by applicable codes and regulations, unless otherwise designated on the Drawings.

4. Corrosive Locations: Wet Well and areas where corrosive materials, including chlorine or sulfur dioxide gas, sodium hypochlorite solutions, sulfuric acid, or liquid polymer are stored or processed. These areas are shown on the Drawings. Specific locations which are defined as Corrosive Locations include:

    a. Hazardous (Classified) Locations: Hazardous (Classified) Locations per the NEC.

PART 2 – PRODUCTS

2.01 STANDARD OF QUALITY

A. It is the intent of these Specifications and Drawings to secure high quality in materials, workmanship, and equipment in order to facilitate operation and maintenance of the facility.

1. Ancillary equipment and materials not identified in these specifications or on the Drawings shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items.

2. For uniformity, only one manufacturer will be accepted for each type of product. Equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for stresses that may occur during fabrication, transportation, erection, and continuous or intermittent operation.

3. Equipment shall be adequately stayed, braced, and anchored and shall be installed in a neat and workmanlike manner.

4. Appearance, as well as utility, shall be given consideration in the design of details.

2.02 GENERAL FASTENERS

A. Fasteners for securing equipment to walls, floors and the like shall be 316 stainless steel.

B. When fastening to existing walls, floors, and the like, provide capsule or wedge anchors, not expansion shields:

1. Size anchors to meet load requirements.

C. Seismic anchorage and bracing per Section 13 05 41.

2.03 PAINTING AND COATING

A. Equipment: Refer to each electrical equipment section of these Specifications for painting and coating requirements of equipment and enclosures.

B. Repair any final finish that has been damaged or is otherwise unsatisfactory using touchup materials approved by the manufacturers, to the satisfaction of the Owner.

PART 3 – EXECUTION

3.01 GENERAL

A. Work shall be performed by craftsmen skilled in their trade.

B. Work shall present a neat and finished appearance.

C. Equipment and material shall be new and free from defects. All material and equipment of the same or similar type shall be of the same manufacturer.

D. Install equipment in strict accordance with the manufacturer's instructions unless directed otherwise:

1. Wherever a conflict occurs between manufacturer's instructions, codes and regulations, or these Contract Documents, follow Engineer's direction.

2. Keep a copy of submitted manufacturer's installation instructions on the job site available for review.

E. Provide protection for materials and equipment against loss or damage:

1. Protect all equipment provided in the Contract and any existing equipment affected by this Contract from the effects of weather (e.g.: new holes in existing equipment for installation of new equipment, etc.).

2. Prior to installation, store items in indoor locations. In addition, items subject to corrosion under damp conditions, and items containing insulation, such as transformers, motors, and control, shall be stored in indoor, heated, dry locations.

F. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation:

1. Cap conduit runs during construction with manufactured seals.

2. Keep openings in boxes or equipment closed during construction.

G. Do not cut or notch any structural member or building surface without specific approval of Engineer:

1. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces neatly to original condition using skilled craftsmen of the trades involved at no additional cost to the Owner.

H. Keep the premises free from accumulation of waste material or rubbish:

1. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of devices and equipment.

2. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish.

I. Label electrical and control equipment, including electrical switchgear, VFD panels, motor starter panels, generator sets, automatic transfer switches, control panels, equipment within electrical and control panels, disconnect switches, motors, pumps, local control stations, instrument transmitters, and analytical controllers.

3.02 FIELD TESTS

A. General:

1. Contractor shall use NETA Acceptance Testing Specifications (ATS) for all new equipment installed under this Contract and NETA Maintenance Testing Specifications (MTS) for all existing equipment reused under this Contract unless otherwise directed by the Project Representative.

2. Give a minimum of 5 working days of notice to the Engineer prior to any test to permit witnessing the test.

3. Testing Contractor shall be NETA certified and shall submit copy of certification for favorable review prior to testing.

4. Record test measurements on applicable NETA test report forms.

5. Prepare and submit a Test Report per NETA standards summarizing the final test procedures and test results.

B. The Contractor shall provide all materials, equipment, labor, and technical supervision to perform such tests and inspections. It is the intent of these tests to ensure that all electrical equipment is operational within industry and manufacturer tolerances and is installed in accordance with the Contract Documents and manufacturer's instructions. The tests and inspections shall determine the suitability for energization.

C. Retesting will be required for all unsatisfactory tests after the equipment or system has been repaired. Retest all related equipment and systems if required by the Engineer.

D. Tests:

1. Testing shall include the tests specified in Division 26 equipment specifications.

2. Insulation Resistance, Continuity, and Rotation:

a. Perform routine insulation resistance, continuity, and rotation tests for all distribution and utilization equipment including all motors, 1/2 horsepower and larger, prior and in addition to tests specified herein.

b. Any system material or workmanship that is found defective on the basis of acceptance tests shall be reported directly to the Engineer.

c. The Contractor shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.

3. Motor Current: Measure and record current in each phase for each new motor over 5 hp. Include measurement of the motor terminal voltages and motor currents when the motor is being operated at normal operating loads. For motors that are fed by variable frequency drives, use true-rms-reading instruments in making test measurements.

4. Operational Tests: Operationally test all circuits to demonstrate that the circuits and equipment have been properly installed, adjusted, and are ready for full-time service. Demonstrate the proper functioning of circuits in all modes of operation including alarm conditions, and demonstrate satisfactory interfacing with the data acquisition and alarm systems.

3.03 RECORD DRAWINGS

A. Maintain a set of As-Built Drawings on site that documents changes made to both the Contract Drawings and approved equipment manufacturer Shop Drawings. Provide a copy of these As-Built Drawings to the Owner/Engineer for approval prior to and as a part of the substantial completion process. Substantial completion will not be awarded if the Drawings are not in an acceptable readable form and approved by the Owner/Engineer.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for furnishing, installation, and connection of conductors and cables rated 600 V used for power, lighting, and receptacle circuits.

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.02 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Submit catalog cut sheets.

C. Submit insulation test results.

PART 2 – PRODUCTS

2.01 CONDUCTORS

A. General: All conductors shall be copper. Wire or cable not specifically shown on the Drawings or specified, but required, shall be of the type and size required for the application and in conformance with the applicable code and/or manufacturer’s requirements. All insulated conductors shall be identified with printing colored to contrast with the insulation color.

B. Power and Control Conductors, 600 V and Below:

1. No. 14 AWG and larger shall be 600 V, copper, stranded, Type XHHW-2, 90 degrees C wet/dry cross-linked polyethylene in accordance with NEMA WC57/ICEA S-73-532 (control cable), NEMA WC70/ICEA S-95-658 (power cable).

2. Fixture wire shall be 600 V, silicone rubber insulated, 200 degrees C, UL Type SF-2, with stranded copper conductors.

3. Flexible cords and cable shall be 600 V, Type SOOW with ethylene-propylene-rubber insulation, in accordance with UL 62. Rated for Extra Hard-Usage. Shall conform to physical and minimum thickness requirements of NEMA WC 8.

4. Cords shall be 600 V, 2-conductor plus ground, Type SO, hard service, of adequate length and with grounding type plug attached, rated in amperes as shown on the Drawings.

5. Manufacturers: Houston Wire and Cable, Southwire, Okonite, or approved equal.

2.02 TYPE TC CABLE

A. Type TC-Power Cable:

1. Description: Multiconductor power cable, No. 8 AWG minimum through 500 kcmil, approved for tray installation and in accordance with UL 1277.

B. Type TC-Control Cable:

1. Description: Multiconductor control cable, No. 10 AWG through No. 14 AWG, approved for tray installation and in accordance with UL 1277.

C. Voltage: 600 V.

D. Conductor Material: Bare annealed copper; stranded in accordance with ASTM B8.

E. Insulation: XHHW-2, 90 degree C dry, 75 degree C wet, cross-linked polyethylene in accordance with NEMA WC57/ICEA S-73-532 (control cable), NEMA WC70/ICEA S-95-658 (power cable), and UL 44.

F. Assembly: Individual conductors cabled together with non-hydroscopic fillers and binding tape.

G. Jacket: 50-mil minimum, polyvinylchloride (PVC) in accordance with UL 1581.

H. Flame resistance: IEEE 383.

I. Manufacturers: Southwire, Okonite, General, Houston Wire & Cable or approved equal.

J. Ratings: Cable Tray; conduit; direct burial; Class 1, Division 2; direct sunlight.

K. Minimum bend radius shall be no greater than 6 times cable diameter.

2.03 VARIABLE FREQUENCY DRIVE (VFD) MULTI-CONDUCTOR CABLE

A. Description: Variable Frequency Drive cable. Three stranded, tinned phase conductors plus three symmetrically-spaced, bare ground wires. XLP insulation with two spiral copper table shields (100 percent coverage). Sun and oil resistant PVC jacket.

B. Voltage: 600 V.

C. Conductor: Tinned copper conductors with 7 by 19 by 19 stranding.

D. Insulation: Flame retardant, cross-linked polyethylene (XLPE), 90 degrees C, wet/dry type XHHW-2 (UL44).

E. Grounding Conductors: Three-stranded bare copper grounds symmetrically located in continuous contact with a copper tape shield.

F. Shielding: Copper tape shield(s) helically wound with 100 percent coverage.

G. Assembly: Three-phase conductors with symmetrically located tri-sectional grounding conductors in continuous contact with a copper tape shield.

H. Overall Jacket: 90C, PVC.

I. Temperature: 90 degree C wet/dry.

J. Approvals: IEEE 383, 70,000 BTU flame test; UL 1277 and UL 1581; tray cable rated (TC); suitable for Class 1, Division 2 hazardous locations.

K. Manufacturers: Anixter-Shawflex VFD Cable, Belden VFD Cable, or approved equal.

2.04 SPLICES AND TERMINATIONS OF CONDUCTORS

A. Splices:

1. Wire and Cable Splicing Materials and Applications:

a. For Lighting Systems and Power Outlets: Wire nuts shall be twist-on type insulated connectors utilizing an outer insulating cover and a means for connecting and holding the conductors firmly. Wire nuts shall be suitable for connecting two to four copper conductors of No. 14 or No. 12 AWG size or two or three No. 10 AWG copper conductors.

b. All Equipment: Crimp-type connectors shall be insulated type, suitable for the size and material of the wires and the number of wires to be spliced and for use with stranded conductors.

c. Equipment and Power Conductors: Bolted pressure connectors shall be suitable for the size and material of the conductors to be spliced. Connectors shall be of the split bolt or bolted split sleeve type in which the bolt or setscrew does not bear directly on the conductor.

d. All Equipment: Epoxy splice kits shall include epoxy resin, hardener, and mold, and shall be suitable for use in wet locations and hazardous locations.

e. All wire and cable splicing materials shall be UL Listed.

2. Terminal Cabinets (Not Marshaling Cabinets): Termination system shall include insulated, crimp-type connectors. Coordinate the lug and boards for correct fit. All terminations shall include marker sleeves.

B. Terminations:

1. Low-Voltage Terminations:

a. Crimp-type terminals shall be UL Listed, self-insulating sleeve type, with ring or rectangular type tongue, suitable for the size and material of the wire to be terminated and for use with either stranded conductors.

b. Terminal lugs shall be Listed and of the split bolt or bolted split sleeve type in which the bolt or setscrew does not bear directly on the conductor. Tongues shall have NEMA standard drilling.

c. Crimp with manufacturer-recommended ratchet type tool with calibrated dyes. Hand crimping tools are not acceptable.

d. Provide VFD cable terminations per cable manufacturer's requirements and recommendations.

C. Tape used for splices and terminations shall be compatible with the insulation and jacket of the cable and shall be of plastic material. Tape shall conform to UL 510.

D. Wire markers shall be heat shrink type (Raychem; T&B; or approved equal). Wire numbers shall be permanently imprinted on the markers.

PART 3 – EXECUTION

3.01 CONDUCTOR INSTALLATION

A. Provide the following types and sizes of conductors for the uses indicated for 600 V or less:

1. Stranded Copper, Sizes No. 12 and No. 10 AWG: As shown on the Drawings for circuits for receptacles, switches, and light fixtures with screw type terminals.

2. Stranded Copper, Size No. 14 AWG and Larger: As shown on the Drawings for the control of motors or other equipment. Size No. 14 shall not be used for power supplies to any equipment.

3. Stranded Copper, Sizes No. 12 AWG and Larger: As shown on the Drawings for motors and other power circuits.

4. Fixture Wire: For connections to all fixtures in which the temperature may exceed the rating of branch circuit conductors.

B. Color Coding: Provide color coding for all circuit conductors. Insulation color shall be white for neutrals and green for grounding conductors. An isolated ground conductor shall be identified with an orange tracer in the green body. Ungrounded conductor colors shall be as follows:

1. 208Y/120 V, Three-Phase, Power: (A) Black, (B) Red, and (C) Blue.

2. 480Y/277 V, Three-Phase, Power: (A) Brown, (B) Orange, and (C) Yellow.

3. 240/120 V, Three-Phase, Power: (A) Black, (B) Orange, and (C) Blue.

   a. Mark high leg of 4-wire grounded delta system per Article 110.15 of the NEC.

4. 120/240 V, Single-Phase, Power: (A) Black and (B) Red.

5. 120 Vac, Control: Red.

6. 24 Vdc Control.

    a. DC Common: White with blue strip.

    b. DC Control (+): Blue.

    c. DC Signal (Discrete): Purple.

7. Analog:

    a. Analog signal (+): White or Red.

    b. Analog signal (-): Black.

C. Color-coding shall be in the conductor insulation for all conductors No. 10 AWG and smaller. For larger conductors, color shall be either in the insulation or in colored plastic tape applied at every location where the conductor is readily accessible (e.g., enclosures, pull boxes, and junction boxes).

D. Exercise care in pulling wires and cables into conduit or wire-ways so as to avoid kinking, putting undue stress on the cables, or otherwise abrading the cables. No grease will be permitted in pulling cables. Only soapstone, talc, or Listed pulling compound will be permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab conduits before installing cables and exercise care in pulling to avoid damage to conductors.

E. Manufacturer's cable-pulling tension shall not be exceeded.

F. Wrap all cables in manholes with fireproofing tape. Extend tape 1 inch into ducts.

G. Cable bending radius shall be per applicable code and manufacturers requirements. Install feeder cables in one continuous length unless splices are favorably reviewed.

H. Provide an equipment-grounding conductor, whether or not it is shown on the Drawings, in all flexible conduit and all raceways.

I. In panels, bundle incoming wire and cables, No. 6 AWG and smaller; lace at intervals not greater than 6 inches; neatly spread into trees; and connect to respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Perform lacing with plastic cable ties or linen lacing twine. Where plastic panel wiring duct is provided for cable runs, lacing is not necessary when the cable is properly installed in the duct.

J. In wire-ways, ty-wrap/secure wire and cables at a minimum of every 4 feet.

K. For cables crossing hinges, utilize extra flexible stranded wire, make up into groups not exceeding 12, and arrange to provide protection from chafing and excess flexing when the hinged member is moved.

L. Install and terminate VFD cable per cable manufacturer's requirements and recommendations.

3.02 CONDUCTOR SPLICES AND TERMINATIONS

A. Splices: Install all conductors without splices unless necessary for installation, as determined by the Engineer. Splices, when permitted, and terminations shall be in accordance with the splice or termination kit manufacturer's instructions. Splice or terminate wire and cable as follows:

   1. Watertight Splices: Splices in concrete pull boxes, for any type of cable or wire, shall be watertight. Make splices in low-voltage cables using epoxy resin splicing kits rated for application up to 600 V.

B. Terminations: Terminate stranded No. 14 wire using crimp-type terminals where not terminated in a box lug-type terminal. Terminals must be coordinated with type of terminal board where provided.

3.03 FIELD TESTS

A. Insulation Resistance Tests:

   1. Perform an insulation resistance test for all circuits 150 V to ground or more and for all motor circuits over 1/2 horsepower.

   2. Test cables per NETA ATS-2017, Section 7.3.2. Submit results for review.

B. Phase Rotation: The phase rotation of all circuits shall be clockwise in sequence as determined with a phase rotation meter and shall produce the standard direction of rotation specified for poly-phase induction motors in NEMA MG1. The Contractor shall verify that each three-phase service, feeder, and branch circuits meet this requirement. A record shall be kept at each circuit tested and, on completion, submitted to the Engineer for review.

END OF SECTION

SECTION 26 05 23

CONTROL VOLTAGE ELECTRICAL POWER CABLES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for furnishing, installing, and connection of conductors and cables for signal and control circuits.

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.02 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Submit catalog cut sheets.

C. Submit insulation test results.

PART 2 – PRODUCTS

2.01 CONDUCTORS

A. General: All conductors shall be annealed copper wire or cable; and if not specifically shown on the Drawings or specified, but required, shall be the type and size required for the application and in conformance with the applicable code. All insulated conductors shall be identified with printing colored to contrast with the insulation color.

2.02 SIGNAL CABLE

A. Twisted Shielded Pairs (TSP):

1. Cable shall be single twisted, shielded pair, cable tray rated (Type TC), 16 AWG, instrumentation cable, UL listed.

2. Voltage: 600 V.

3. Conductor: Bare annealed copper, stranded in accordance with ASTM B-8.

4. Conductor Insulation: 15-mil, 90 degree C, polyvinylchloride (PVC).

5. Jacket: 45-mil PVC.

6. Standards: UL 1277, IEEE383, UL listed as Type TC.

7. Approved for Use: Indoors or outdoors; wet or dry locations; in cable trays; in raceways; for direct burial; and in Class I, Division 2 location (NEC Article 501).

8. Manufacturers: Okonite: Okoseal-N Type P-OS, Type TC Instrumentation Cable, General Cable, Southwire, or approved equal.

2.03 NETWORK CABLE

A. Ethernet Cable – CAT 5e:

1. Cable shall exceed Category 5e component transmission requirements specified in ANSI/TIA/EIA-568-B and shall be tested to 100 MHz.

2. UL Listed, Type PLTC (Tray Cable) 600 V, 80C cable.

3. Cable shall exceed IEEE 802.3 DTE Power specification to the rated current limits with no degradation of performance or materials.

4. Cable shall be error free Gigabit Ethernet performance to IEEE 802.3.

5. Cable shall exceed the requirements of TIA/TSB-155: 1 Gb/s Ethernet Operation over 55 Meters Channel Length.

6. Cable shall meet or exceed the 4-connector channel performance requirements of Category 5e, per the ANSI/TIA/EIA-568-C.2 standard.

7. Product: The cable shall be designed and intended for installation in an industrial environment. Construction shall include four twisted pairs of 22 AWG insulated stranded tinned copper conductors with an overall foil and braid shield.

8. Overall Cable Insulation Voltage Rating: 600 V.

9. Connector: 50-micron gold plated RJ-45.

10. Warranty: minimum 1 year.

2.04 TERMINATION OF CONDUCTORS

A. Low-Voltage Terminations:

1. Crimp-type terminals shall be UL listed, self-insulating sleeve type, with rectangular-type tongue, suitable for the size and material of the wire to be terminated and for use with stranded conductors.

2. Crimp with manufacturer-recommended type tool with calibrated dyes. Hand-crimping tools are acceptable if approved by original equipment manufacturer (OEM).

PART 3 – EXECUTION

3.01 CONDUCTOR INSTALLATION

A. Exercise care in pulling wires and cables into conduit or wire-ways so as to avoid kinking, putting undue stress on the cables, or otherwise abrading them. No grease will be permitted in pulling cables. Only soapstone, talc, or UL-listed pulling compound will be permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab conduits before installing cables, and exercise care in pulling to avoid damage to conductors.

B. Manufacturer's cable-pulling tension shall not be exceeded.

C. Cable-bending radius shall be per applicable code and manufacturer's requirements.

D. Adequate care shall be exercised by the installers to prevent cable damage or sheath distortion. Bending radius follow manufacturer's requirements and shall not be less than ten times overall diameter of the cable.

E. Wrap all cables in manholes with fireproofing tape. Extend tape 1 inch into ducts.

F. No splices unless indicated on Drawings.

G. Provide an equipment-grounding conductor, whether or not it is shown on the Drawings, in all flexible conduit and all raceways.

H. For cables crossing hinges, utilize extra-flexible stranded wire, make up into groups not exceeding 12, and arrange so that the cables will be protected from chafing and excess flexing when the hinged member is moved.

I. Cables shall be installed and terminated by personnel who have had a minimum of 3 years of experience in terminating and splicing instrumentation and control cables including experience with twisted shielded conductors, coaxial cables, and thermocouple extension cables.

J. Cables shall be continuous from initiation to termination without splices except where specifically indicated.

K. Where installed in control consoles containing power circuits, cables shall be routed a minimum of 2 inches apart from power circuits. Color coding shall be strictly observed throughout the installation.

L. In wireways, ty-wrap/secure wire and cables at a minimum of every 4 feet.

M. Conductor Splices and Terminations:

1. Splices:

a. Install all conductors without splices, unless necessary for installation as determined by the Engineer. Splices, when permitted, and terminations shall be in accordance with the splice or termination kit manufacturer's instructions. Splice cables as follows:

1) Watertight Splices: Splices in concrete pull boxes, for any type of cable or wire, shall be watertight. Make splices in low-voltage cables using epoxy-resin splicing kits rated for application up to 600 V.

2) Shield shall be handled as a separate conductor. Use manufacturer's compression sleeve and insulated pigtail. Keep pigtail as short as possible. Terminate pigtail with marker sleeve and tug.

b. No splicing is acceptable for coaxial cables.

N. Signal Cable:

1. Cable shielding shall be grounded at one end only of the cable. Bonding shall be to a single ground point only. Bonding from cable-to-cable in multiple-run installations shall not be permitted.

2. Heat-shrinkable sleeving shall be installed on all cables to insulate shielding at the ungrounded cable terminations.

3. Terminations:

a. Crimp-type terminals shall be UL listed, self-insulating, sleeve type with rectangular tongue, suitable for size and material of the wire to be terminated and for use with stranded wire. Spade-type lugs are acceptable with telephone-cable systems only.

b. Crimp with manufacturer's recommended ratchet-type tool with calibrated dyes. Hand-crimping tools are not acceptable.

c. Coaxial cable and connectors shall be terminated in accordance with the manufacturer's instructions. Use manufacturer's recommended solder. The Contractor shall prevent misapplication of solder and termination.

3.02 TESTING

A. Insulation Test:

1. Disconnect the conductor under test from all equipment.

2. Use a 500 V megger to test the insulation of:

   a. Each conductor to ground.

   b. Each conductor to all other conductors in same cable.

   c. Each conductor to the shield.

   d. Each shield to ground.

3. The minimum acceptable insulation resistance is 25 mega-ohms.

4. Record each insulation measurement. Include test date and the name of the person performing the test on the test data form.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for furnishing, installation, and connection of electrical grounding equipment.

B. This section specifies the system for grounding electrical equipment, exposed non-energized metal surfaces of equipment, and metal structures.

C. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.02 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Submit catalog cut sheets.

C. Shop Drawings.

D. Test data.

PART 2 – PRODUCTS

2.01 GENERAL

A. The grounding systems shall consist of the ground rods, grounding conductors, ground bus, ground fittings and clamps, and bonding conductors to water piping and structural steel as shown on the Drawings or as required to meet the requirements of the NEC. One system shown provides service and separately derived system grounds. A second system is an electronic ground system to provide for the discharge of static electricity.

2.02 SYSTEM COMPONENTS

A. Ground Rods:

1. Ground rods shall be cone-pointed, copper-clad Grade 40 HS steel rods conforming to ASTM B228.

2. The welded copper encased steel rod shall have a conductivity of not less than 27 percent of pure copper.

3. Rods shall be not less than 3/4 inch in diameter and 10 feet long, unless otherwise indicated.

4. Rods longer than 10 feet shall be made up of 10-foot units joined together with threaded couplings. Increase rod diameter sufficiently to prevent the rod from bending or being damaged.

5. The manufacturer's trademark shall be stamped near the top.

B. Ground Conductors:

1. Buried conductors shall be medium-hard drawn bare copper; other conductors shall be soft drawn copper.

2. Sizes over No. 6 AWG shall be stranded.

3. Coat all ground connections, except the exothermic welds, with electrical joint compound, nonpetroleum type, listed for copper and aluminum applications.

4. If cable sizes are not specified, the minimum sizes shall be as follows:

a. 15 kV – 480 V Transformer: 250 MCM

b. 15 kV Load Interrupter: 4/0 AWG

c. 480 V Switchgear: 4/0 AWG

d. 480 V MCC and Switchboards: 2/0 AWG

e. Lighting Panels: 1/0 AWG

f. Exposed Metal: 2 AWG

g. Control Panels: 12 AWG

C. Ground Connections:

1. Exothermic Connectors:

a. Connection to ground rods and buried connections shall be by exothermic weld.

b. Manufacturers: Thermoweld, Cadweld, or approved equal.

2. Binding Post Connectors:

a. Lugs for attachment of cables to steel enclosures shall be of the binding post type with a 1/2-13 NC stud.

b. Each post shall accommodate cables from No. 4 AWG to No. 4/0 AWG.

3. Irreversible Compression Connectors:

a. Cast copper.

b. Manufacturers: Thomas and Betts, Burndy, or approved equal.

4. Bolted Connectors:

    a. Manufacturers: Burndy, O. Z. Gedney, or approved equal.

D. Ground Rod Boxes:

1. Boxes shall be 9-inch-diameter precast concrete units with hot-dip galvanized traffic covers.

2. Units shall be 12 inches deep.

3. Covers shall be embossed with the wording “Ground Rod.”

E. Ground Bus:

1. Ground bus shall be a high-conductivity copper-alloy strap measuring 3/16 inch by 1 1/4 inch and of lengths as shown on the Drawings.

2. Bus shall be predrilled and tapped to accept 8/32 brass machine screws on 12-inch centers.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Ground all equipment for which a ground connection is required per NEC whether or not the ground connection is specifically shown on the Drawings.

B. Provide a ground rod box for each ground rod so as to permit ready access for the connection and/or removal of any pressure connectors to facilitate testing.

C. Bond metallic water piping at its entrance into each building. Ground separately derived electrical system neutrals to the metallic water piping in addition to the system driven ground per NEC requirements.

D. Make embedded or buried ground connections, taps, and splices with irreversible compression connectors or exothermic welds. Coat ground connections.

E. Effectively bond structural steel for buildings to the grounding system using exothermic welds.

F. Prior to making ground connections or bonds, clean metal surface at the point of connection.

G. Install rubber mats in front of low-voltage switchboards and switchgear, medium-voltage switchgear, and motor control centers.

3.02 RACEWAY GROUND

A. Metallic Conduits:

1. Assembled to provide a continuous ground path and bonded using insulated grounding bushings.

2. Bond using insulated grounding bushings.

B. Non-Metallic Conduits: Insulated ground conductor sized in compliance with the NEC.

C. Grounding Bushings: Connected to the grounding system using conductors sized in compliance with NFPA 70.

D. Provide a ground wire in every conduit carrying a circuit of over 50 V to ground.

E. Cable tray shall be bonded to the grounding electrode system.

3.03 EQUIPMENT AND ENCLOSURE GROUND

A. Connect electrical and distribution equipment to the grounding system. Cables sized as specified.

B. Connect non-electrical equipment with metallic enclosures to the grounding system.

C. Securely bond transformer yard fences and gates as specified.

3.04 TESTING

A. Conduct ground-resistance tests using a ground megohmmeter with a scale reading of 25 ohms maximum.

B. Test methods shall conform to NETA Standard ATS using the three-electrode method. Conduct tests only after a period of not less than 48 hours of dry weather.

C. Maximum resistance shall be 5 ohms. If 5 ohms cannot be achieved, add additional ground rods and ground grid conductors until the maximum resistance is achieved. If soil conditions provide that this value is impossible to achieve, add ground rods and conductors to achieve the lowest resistance realistic and submit to the Engineer for favorable approval. If Engineer does not approve the value and configuration, follow Engineer's direction for further reduction of ground resistance.

D. Furnish to the Engineer a test report with recorded data of each ground rod location.

E. Furnish a separate report on the rubber mats. Make measurements in conformance with manufacturer's instructions.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for hangers and supports for electrical systems.

B. Refer to Section 26 05 00, “Common Work Results for Electrical, for quality assurance, submittal procedures, and other requirements.

1.01 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Submit catalog cut sheets.

C. Submit sealed structural Drawings when raceway and cable tray support systems require design by a registered Engineer.

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Delegated Design: The following systems shall be designed and sealed by a Washington State Registered Professional Structural Engineer to ensure conformance with IBC seismic, building, and load requirements:

   a. Cable tray support systems.

   b. Suspended raceway supports.

2. Raceway and cable tray supporting systems, structures, and elements shall be designed to meet seismic and other building structural requirements and to support the static and dynamic load of the wiring and raceways that they will carry.

3. Seismic anchorage and bracing per Section 13 05 41.

PART 2 – PRODUCTS

2.01 RACEWAY SUPPORTS

A. Conduit Supports:

1. Provide hot-dip galvanized framing channel with end caps to support groups of conduit. All associated hardware shall be hot-dip galvanized.

2. Individual conduit supports shall be one-hole hot-dip galvanized malleable iron pipe straps used with galvanized clamp backs and nesting backs where required.

3. Conduit supports for PVC-coated rigid steel and PVC conduit systems shall be one-hole PVC-coated rigid steel or clamps conduit wall hangers.

4. In corrosive areas (e.g., inside and on top of Headworks Building), all conduit support hardware (e.g., channels, strut, threaded rods, nuts, anchors, and clamps) for single and multiple conduits shall be 316 stainless steel unless specified on Drawings.

B. Ceiling Hangers:

1. Unless otherwise indicated, ceiling hangers shall be adjustable galvanized carbon steel rod hangers as specified. Straps or hangers of plumber's perforated tape are not acceptable.

2. Unless otherwise indicated, hanger rods shall be 1/2-inch all-thread rod and shall meet ASTM A193.

3. Hanger rods in corrosive areas and those exposed to weather or moisture shall be 316 stainless steel.

C. Suspended Raceway Supports (Racks):

1. Unless otherwise indicated, suspended raceway supports shall consist of concrete inserts, galvanized carbon steel rod hangers, and jamb nuts supporting hot-dip galvanized framing channel or lay-in pipe hangers as required.

2. Unless otherwise indicated, hanger rods shall be 1/2-inch all-thread rod and shall meet ASTM A193.

3. Brace all suspended raceway supports at 30-foot intervals (alternating from one side to the other) to meet specified seismic requirements.

4. Suspended raceway supports in corrosive areas and those exposed to weather or moisture shall be 316 stainless steel.

2.02 GENERAL FASTENING AND SUPPORT HARDWARE

A. Unless otherwise specified, all fasteners, anchors, clamps, supports, strut, plates, posts, and brackets shall be 316 stainless steel. When fastening to existing walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8 inch.

PART 3 – EXECUTION

3.01 GENERAL

A. Treat exposed mail threads, cut surfaces, and damaged ends with corrosion-resistant coatings, such as "Devcon Z" prepared by Subox Coatings, "Galvanox Type I" prepared by Pedley-Knowles, or approved equal. Application shall follow manufacturer's recommendation.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for furnishing, installation, and connection of electrical conduits, wireways, pull boxes, and fittings. Raceways shall be provided for all wiring unless shown or specified otherwise.

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.02 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Submit catalog cut sheets.

PART 2 – PRODUCTS

2.01 RACEWAY

A. Requirements for raceway types are listed in the RACESPECs sheets at the end of this section.

2.02 BOXES AND FITTINGS

A. Junction Boxes, Pull Boxes and Wiring Gutters:

1. Indoor:

   a. Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square. NEMA 12 welded steel 6 inches square and larger. Door shall have hinges with clamp locks. Boxes in process areas shall be NEMA 4 watertight.

   b. Conduit Bodies: Ferrous alloy type with screw taps for fastening covers. Gaskets shall be made of neoprene.

2. Outdoor:

   a. Type FD cast ferrous for all devices and for junction boxes less than 6 inches square. NEMA 4X stainless steel for 6 inches square and larger.

3. Outdoor boxes and enclosures shall be provided with neoprene gaskets on the hinged doors or removable covers.

4. Boxes and enclosures in indoor corrosive areas shall be NEMA 4X stainless steel or nonmetallic.

5. Boxes in classified areas shall be NEMA Class 7 galvanized cast ferrous.

6. Box and gutter sizes, metal thickness, and grounding shall comply with the National Electrical Code.

7. Bolt-on junction box covers 3 feet square or larger, or heavier than 25 pounds, shall have a rigid handle.

8. Covers larger than 3 by 4 feet shall be split.

B. Conduit Seals:

1. Conduit seals shall be explosion-proof with a minimum 40 percent wire fill capacity of the EYSX type. Where shown on Drawings, use retrofit conduit sealing fittings of the EYSR type.

2. Install conduit seals for use in classified areas as shown on Drawings or where any conduit leaves the classified space.

3. Use PVC-coated fittings with urethane interior coating for PVC-coated GRS; use copper free cast aluminum for rigid aluminum.

4. The sealing compound shall be as prescribed by the manufacturer of the sealing conduit body.

5. Use the sealant, such as Chico, in areas that are defined as hazardous and meet the NEC requirements for Article 500.

2.03 UNDERGROUND MARKING TAPE

A. Six-inch-wide, detectable, metallic-lined tape with red polyethylene film on top and clear polyethylene film on the bottom.

B. Tape legend shall be clearly printed with black over red tape and shall read “CAUTION ELECTRIC LINE BURIED BELOW.”

C. Use for early warning protection of underground raceways.

D. Manufacturers: Brady “Identoline,” Services and Materials “Buried Underground Tape,” Somerset (Thomas & Betts) “Protect-A-Line,” or approved equal.

2.04 FIRESTOPS

A. Apply in accordance with manufacturer’s recommendations.

B. Manufacturers: Flamemastic 77, Vimasco No. 1-A, or approved equal.

C. Products which are affected by water are not acceptable.

PART 3 – EXECUTION

3.01 GENERAL

A. Specific raceway types and applications are indicated on the Drawings and/or in the raceway schedule. When not indicated on the Drawings and/or in the raceway schedule Table A specifies the type of raceway required for each location and application by RACESPEC sheet. Use fittings, hubs, and boxes as specified by the raceway type in RACESPEC. Unless otherwise indicated, in Table A, unscheduled conduit shall be galvanized, rigid steel, RACESPEC type GRS.

TABLE A

Location	Application/Condition	RACESPEC
Indoor noncorrosive	Exposed	GRS
Indoor corrosive	Exposed; includes Wet Well location	PRS
Outdoor	Exposed	PRS
Concealed	Embedded in concrete structure or beneath slab-on-grade	PVC40
Underground	Instrumentation, communications and data signals encased in concrete, duct bank	GRS
Underground	Instrumentation, communications and data signals directly buried	PRS
Underground	Power and control directly buried	PVC40
Underground	Power and control encased in concrete, duct bank	PVC40
Nonhazardous	Final connection to equipment and light fixtures	LFS
Underground	Telephone service direct buried	PVC80
Architecturally finished areas	Final connection to light fixtures	FLEX
Transition	Above-grade to/from below-grade	PRS

3.02 CONDUIT

A. General:

1. The number of directional changes of a conduit shall be limited to 270 degrees in any run between pull boxes.

2. Conduit runs shall be limited to a maximum of 400 feet, less 100 feet or fraction thereof, for every 90 degrees of change in direction.

3. Provide conduit and raceway systems that are electrically continuous per electrical code requirements or provide additional ground conductors as required by the electrical code.

B. Indoor and Outdoor Conduit Systems:

1. Unless otherwise indicated, in general, conduit inside structures shall be exposed.

2. Unless otherwise indicated, the Contractor shall be responsible for determining conduit routing that conforms to the installation requirements set forth herein.

3. Install conduit to conform to the requirements of the RACESPEC sheets and the following:

   a. Install exposed conduit either parallel or perpendicular to structural members and surfaces.

   b. Two or more exposed conduits in the same general routing shall be in parallel with symmetrical bends.

   c. Exposed conduit shall be run on supports spaced not more than 10 feet apart.

   d. Where three or more conduits are located in parallel run, space them out from the wall using framing channel.

   e. Where conduits are suspended from the ceiling, support systems shall comply with the requirements of Section 26 05 29, “Hangers and Supports for Electrical Systems.”

   f. Secure conduit rack supports to concrete walls and ceilings by means of cast-in-place anchors or framing channel concrete inserts.

   g. Conduits shall be at least 6 inches from high temperature piping, ducts, and flues with temperatures higher than 90 degrees C.

   h. Install conduits between the reinforcing steel in walls or slabs which have reinforcing in both faces. In slabs which have only a single layer of reinforcing steel, place conduits under the reinforcement.

   i. Route conduit clear of structural openings and indicate future openings.

   j. Flash and seal watertight those conduits which pass through roofs or metal walls.

   k. Neatly group conduit into any openings cut into concrete and masonry structures, and grout using non-shrink type grout.

   l. During construction, cap conduits to prevent entrance of dirt, trash, and water.

   m. Terminate exposed conduit stubs for future use with galvanized pipe caps.

   n. Determine concealed conduit stub-up locations from the manufacturer’s Shop Drawings.

o. Terminate concealed conduit for future use in equipment or by galvanized couplings plugged flush with structural surfaces.

p. Where the Drawings indicate future duplication of equipment wired hereunder, provide concealed portions of conduits for future equipment.

q. Conduit installed horizontally shall allow headroom of at least 7 feet except where it may be installed along structures, piping, and equipment, or in other areas where headroom cannot be maintained because of other considerations.

r. Terminate all conduits that enter enclosures by fittings that ensure that the NEMA rating of the enclosure is not affected or changed.

s. Transitions from concealed or underground or embedded locations to exposed or above-grade locations shall be made using PVC-coated rigid steel conduit for a distance of at least 12 inches on either side of transition. Connect underground metallic or nonmetallic conduit that turns out of concrete, masonry, or earth to a 90-degree elbow of PVC-coated rigid steel conduit before emergence.

t. Conduit across structural joints where structural movement is allowed shall have an OZ-Gedney “Type DX” or Crouse-Hinds “Type XD,” bonded, weathertight expansion and deflection fitting of that conduit size.

u. Treat cut surfaces or damaged ends with corrosion-resistant coatings, such as “Devcon Z” prepared by Subox Coatings, “Galvanox Type I” prepared by Pedley-Knowles, or approved equal. Application shall follow manufacturer’s recommendation.

v. At all boxes and equipment, provide insulated-type metallic grounding bushings for metallic conduits. Bond together all conduits to provide continuity of the equipment grounding system. Size bonding conductor per NEC.

w. Clean, cap/plug, and provide all spare raceways with a nylon pull rope.

C. Underground Conduit Systems:

1. All excavation, backfilling, and concrete work shall conform to respective sections of these Specifications. Underground conduit shall conform to the following requirements:

a. Exposed outdoor conduit risers shall continue to 3 inches above grade, with top crowned and edges chamfered.

b. Unless otherwise indicated, underground conduits and conduit banks shall have 2 feet minimum earth cover.

c. Using a special rubber gasketed sleeve and joint assemblies, or with sleeves and modular rubber sealing elements, seal watertight those conduits not encased in concrete and passing through walls that have one side in contact with earth.

d. Immediately upon completion of pouring concrete, thoroughly swab conduits on the inside. After the concrete has set, and before backfilling, pull a mandrel, having

a diameter equal to the nominal conduit inside diameter minus 1/2 inch, and not less than 4 inches long, through each conduit. If the mandrel showed signs of protrusions on the inside of the conduit, repair or replace the conduit.

e. Clean, cap/plug, and provide all spare raceways with a nylon pull rope.

2. Provide detectable underground marking tape placed 6 to 12 inches below finished grade and directly above the conduit.

3. Transition from Underground to Above Grade: Provide PRS conduit sweep and PRS conduit riser to a distance of at least 12 inches above grade.

4. Underground sweeps shall be PRS unless otherwise noted on the Drawings.

5. Unless otherwise indicated, use 6-inch coarse sand backfill on all sides of underground conduit.

D. Existing Conduit Systems:

1. Where existing conduit raceways are utilized:

a. Blow out the conduit using compressed air to remove foreign material and water. Pull wire brush through conduit and blow out the conduit a second time using compressed air.

b. Pull a test mandrel having a diameter equal to the nominal conduit inside diameter minus 1/2 inch, and not less than 4 inches long, through each spare conduit. If the mandrel showed signs of protrusions on the inside of the conduit, repair or replace the conduit. Notify the Engineer if the existing conduit cannot be utilized.

c. Clean up conduit threads at exposed conduit ends using a wire brush.

d. Treat minor surface rust with a cleaning agent and apply zinc, rust inhibiting coating to the damaged area.

3.03 RACEWAY SPECIFICATION (RACESPEC) SHEETS

A. The following RACESPECs are included in this section:

RACESPEC Symbol	Raceway Description
FLEX	Flexible steel conduit
GRS	Rigid steel conduit
LFS	Liquidtight flexible steel conduit
PRS	PVC coated rigid steel conduit
PVC40	Schedule 40 PVC conduit

RACESPEC Symbol	Raceway Description
PVC80	Schedule 80 PVC conduit
RAC	Rigid Aluminum Conduit
SS	Rigid stainless steel conduit
WW	Wireway and auxiliary gutter

Raceway Identification:	FLEX
Description:	Flexible steel conduit.
Application:	Final connection to lighting fixtures in architecturally finished areas only.
Compliance:	UL 1.
Construction:	Spirally-wound galvanized steel strip with successive convolutions securely interlocked.
Minimum Size:	1/2 inch.
Fittings:	Compression type.
Other:	FLEX shall be provided with an internal ground wire.
Installation:	Flexible steel conduit shall be made up tight and with conductive “coppershield” thread compound.

Raceway Identification:	GRS
Description:	Rigid steel conduit.
Compliance:	ANSI C80.1, UL 6.
Finish:	Hot-dip galvanized after fabrication, inside and outside. Smooth finished surfaces.
Manufacturers:	Allied Tube and Conduit Corp., Wheatland Tube Co., or approved equal.
Minimum Size:	Unless otherwise specified, 3/4 inch for exposed, 1 inch for embedded, encased, or otherwise inaccessible.
Fittings:	Hubs: Insulated throat with bonding locknut, hot-dip galvanized. The hubs shall utilize a neoprene O-ring and shall provide a watertight connection. O-Z Gedney, CHM-XXT, or approved equal.
Unions:	Electrogalvanized ferrous alloy type Appleton UNF or UNY, Crouse-Hinds UNF or UNY, or approved equal. Threadless fittings are not acceptable.
Boxes:	
Indoor:	Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square. NEMA 12 welded steel 6 inches square and larger. Door shall have hinges with clamp locks. Boxes in process areas shall be NEMA 4 watertight.
	Conduit Bodies: Ferrous alloy type with screw taps for fastening covers. Gaskets shall be made of neoprene.
Outdoor:	Type FD cast ferrous for all devices and for junction boxes less than 6 inches square. NEMA 4X stainless steel for 6 inches square and larger.
Corrosive:	NEMA 4X stainless steel.
Hazardous:	NEMA Class 7 cast ferrous.
Elbows:	
3/4 through 1-1/2 Inches:	Factory fabricated or field bent.
2 through 6 Inches:	Factory fabricated only.
Conduit Bodies:	
3/4 through 4 Inches:	Malleable iron, hot-dip galvanized, unless otherwise noted. Neoprene gaskets for all access plates. Tapered threads for all conduit entrances.
5 Inch and 6 Inch:	Electrogalvanized iron or cast iron box.
Expansion Fittings:	Expansion fittings in embedded runs shall be watertight and shall be provided with an internal bonding jumper. The expansion material shall be neoprene and shall allow for 3/4-inch movement in any direction.
Manufacturers:	Appleton, Crouse-Hinds, Hubbell, O.Z. Gedney, or approved equal.

Installation:

Rigid steel conduit shall be made up tight and with conductive “coppershield” thread compound. Joints shall be made with standard couplings or threaded unions. Steel conduit shall be supported away from the structures using hot-dip galvanized malleable iron straps with nesting backs.

Conduit entering boxes shall be terminated with a threaded hub with a grounding bushing.

Exposed male threads or rigid steel conduit shall be coated with zinc-rich paint.

Raceway Identification:	LFS
Description:	Liquidtight flexible steel conduit.
Application:	Final connection to equipment subject to vibration or adjustment.
Compliance:	UL 360.
Construction:	Spirally-wound galvanized steel strip with successive convolutions securely interlocked and jacketed with liquidtight plastic cover.
Minimum Size:	3/4 inch.
Fittings:	
General:	Watertight, outdoor and wet rated. Grounding ferrule shall be threaded to engage conduit spiral. Provide O-ring seals around the conduit and box connection and insulated throat. Forty-five and 90-degree fittings shall be used where applicable.
Dry Locations:	Material: Cadmium-plated malleable iron body and gland nut with cast-in lug, brass.
Wet, Outdoor or Corrosive Locations:	Material: Stainless steel.
Installation:	The length of flexible liquidtight conduit shall not exceed 15 times the trade diameter of the conduit. The length of liquidtight conduit shall not exceed 36 inches. Liquidtight flexible steel conduit shall be made up tight and with conductive “coppershield” thread compound.

Raceway Identification:	PRS
Description:	Rigid steel conduit, corrosion-resistant, polyvinyl chloride (PVC) coated.
Compliance:	ANSI C80.1, UL 6, NEMA RN1.
Finish:	PRS shall be hot dipped galvanized rigid steel conduit. The inside and outside, as well as the threads shall be galvanized. A minimum 40-mil thick PVC coating shall be bonded to the outside of the conduit and the inside shall be coated with 2-mil urethane. Coating shall be free of pinholes. Bending of conduit shall not damage either the interior or exterior coating. Bond strength shall exceed the tensile strength of the PVC coat. Elbows shall be factory made and coated.
Minimum Size:	3/4 inch.
Fittings:	Similarly coated to the same thickness as the conduit and provided with Type 316 stainless steel hardware. A 2-mil urethane coating shall be applied to the interior, and the threads of all fittings and couplings. Conduit and fittings shall be manufactured by the same company.
Hubs:	Hubs for connection of conduit to junction, device, pull, or terminal boxes shall be threaded and made of cast ferrous alloy. Hubs shall be galvanized steel and have insulating bushings. The hubs shall utilize a neoprene O-ring and shall provide a watertight connection.
Boxes:	
Nonhazardous:	NEMA 250, Type 4X stainless steel.
Hazardous:	NEMA 250, Type 7D cast ferrous.
Installation:	PVC-coated conduit shall be supported away from the structure using PVC-coated conduit wall hangers. All conduit threads shall be covered by a plastic overlap which shall be coated and sealed per manufacturer's recommendations. Plastic coated conduit shall be made tight with special wrenches and fittings designed for tightening PVC-coated conduit. All threads shall be protected against corrosion per NEC 300.6 (a) by liberally applying an approved electrically conductive, corrosion-resistant compound – "coppershield." Pipe wrenches and channel locks shall not be used for tightening plastic coated conduits. Damaged areas, including threads, shall be patched, using manufacturer's recommended material. The area to be patched shall be built up to the full thickness of the coating. Painted fittings are not acceptable.

Raceway Identification:	PVC40
Description:	Rigid nonmetallic polyvinylchloride conduit for normal duty applications including direct burial.
Compliance:	NEMA TC2, UL 651.
Construction:	Schedule 40, polyvinylchloride (PVC).
Minimum Size:	3/4 inch exposed; 1 inch embedded or encased.
Fittings:	PVC solvent weld type.
Boxes:	
Indoor:	NEMA Class 4, nonmetallic.
Outdoor and Corrosive:	NEMA Class 4X, nonmetallic.
Installation:	Exposed PVC conduit shall be run on supports spaced not more than 3 feet apart for conduits up to 1 inch 5 feet apart for conduits 1-1/4 inches to 2 inches and 6 feet apart for conduits 2-1/2 inches and larger. PVC conduit shall not be provided where it will be damaged by heat. PVC conduit shall have bell ends where terminated at walls.

Raceway Identification:	PVC80
Description:	Rigid nonmetallic conduit, extra heavy wall thickness for all locations including direct bury under roadways and where exposed to physical damage.
Compliance:	NEMA TC2, UL 651.
Construction:	Schedule 80, high-impact, polyvinylchloride (PVC).
Minimum Size:	3/4 inch exposed; 1 inch embedded or encased.
Fittings:	PVC solvent weld type.
Boxes:	
Indoor:	NEMA Class 4, nonmetallic.
Outdoor and Corrosive:	NEMA Class 4X, nonmetallic.
Installation:	Exposed PVC conduit shall be run on supports spaced not more than 3 feet apart for conduits up to 1 inch 5 feet apart for conduits 1-1/4 inches to 2 inches and 6 feet apart for conduits 2-1/2 inches and larger. PVC conduit shall not be provided where it will be damaged by heat.
	PVC conduit shall have bell ends where terminated at walls.

Raceway Identification: RAC

Conduit:

- Description: Rigid Aluminum Conduit manufactured from 6063 alloy with T-1 temper.
- Finish: Corrosion resistant aluminum.
- Compliance: UL6A, ANSI C80.5, WW-C-540c.
- Construction: Corrosion resistant aluminum
- Manufacturer: Allied Tube and Conduit Corp., Wheatland Tube Co., or approved equal.
- Minimum Size: Unless otherwise specified, 3/4 inch for exposed, 1 inch for embedded, encased, or otherwise inaccessible.
- Elbows:
  - 3/4 through 1 Inch: Factory fabricated or field bent with approved bender.
  - 1-1/2 through 4 Inch: Factory fabricated only.

Fittings:

- Conduit Bodies:
  - Material/Finish: Cast copper-free aluminum.
  - Size: 3/4 inch through 4 inch.
  - Cover: Stamped, domed top, copper-free aluminum with neoprene gasket. Stainless steel screws. Conduit body with gasketed cover shall be outdoor, raintight, wet location rated.
  - Compliance: UL514B, Fed spec W-C-586D, NEMA FB-1.
- Hubs: Watertight, gasketed, copper-free aluminum, insulated throat with ground screw.
- Unions: copper-free aluminum type Appleton UNF or UNY, Crouse-Hinds UNF or UNY, or approved equal. Threadless fittings are not acceptable.
- Conduit Seals: Copper-free aluminum, Type EYSX.
- Manufacturers: Crouse-Hinds, O.Z. Gedney, or approved equal.

Boxes:

- Indoor/Dry Locations: Locations which are both indoor and dry.
  - Less than 6 in. sq.: Type FD copper-free aluminum for all device boxes. Copper-free aluminum covers with stainless steel screws. Gasketed, watertight, wet-rated for process areas.
  - 6 in. sq. and larger: NEMA 12 rated, welded copper-free aluminum with hinged door and clamp lock.

Boxes within process areas shall be NEMA 4 welded copper-free aluminum.

Outdoor Locations:

Less than 6 in. sq.: Type FD copper-free aluminum for all device boxes. Copper-free aluminum covers with stainless steel screws. Gasketed, watertight, wet-rated.

6 in. sq. and larger: NEMA 4 rated, welded copper-free aluminum with hinged door and clamp lock.

Manufacturers: Crouse-Hinds, O.Z. Gedney, or approved equal.

Hazardous Areas: Copper-free aluminum, NEMA 7, Explosionproof, raintight and wet location rated.

Installation: Aluminum conduit shall be made up tight and with approved, conductive “Aluminum Antioxidant Joint Compound.” Joints shall be made with standard couplings or threaded unions. Where not shown on Drawings, support RAC and associated components using stainless steel supports which include a non-conductive barrier between the stainless steel and the aluminum to prevent galvanic corrosion.

Conduit entering boxes shall be terminated with a threaded hub with a grounding bushing.

Aluminum conduit is not to be installed in concrete or soil unless shown on the Drawings. For aluminum conduit that is installed in concrete or in contact with soil, supplementary corrosion protection, such as paints or wraps approved for the purpose, is required.

Raceway Identification:	SS
Description:	Rigid stainless steel conduit.
Compliance:	ANSI C80.1, UL 6.
Material:	316 stainless steel.
Manufacturers:	Calbrite or approved equal.
Minimum Size:	Unless otherwise specified, 3/4 inch for exposed, 1 inch for embedded, encased, or otherwise inaccessible.
Fittings:	Hubs: bonding locknut, 316 stainless steel. The hubs shall utilize a neoprene O-ring and shall provide a watertight connection.
Unions:	316 stainless steel. Threadless fittings are not acceptable.
Boxes:	
Indoor:	Type FD cast 316 stainless steel for all device boxes and for junction boxes less than 6 inches square. NEMA 12 welded steel 6 inches square and larger. Door shall have hinges with clamp locks. Boxes in process areas shall be NEMA 4X watertight.
	Conduit Bodies: 316 stainless steel type with screw taps for fastening covers. Gaskets shall be made of neoprene.
Outdoor:	Type FD cast 316 stainless steel for all devices and for junction boxes less than 6 inches square. NEMA 4X stainless steel for 6 inches square and larger.
Corrosive:	NEMA 4X stainless steel.
Hazardous:	NEMA Class 7 cast 316 stainless steel.
Elbows:	
3/4 through 1-1/2 Inch:	Factory fabricated or field bent.
2 through 6 Inch:	Factory fabricated only.
Conduit Bodies:	
3/4 through 4 Inch:	316 stainless steel. Neoprene gaskets for all access plates. Tapered threads for all conduit entrances.
Expansion Fittings:	Expansion fittings in embedded runs shall be watertight and shall be provided with an internal bonding jumper. The expansion material shall be neoprene and shall allow for 3/4-inch movement in any direction.
Installation:	Rigid stainless steel conduit shall be made up tight and with conductive “coppershield” thread compound. Joints shall be made with standard couplings or threaded unions. Rigid stainless steel conduit shall be supported away from the structures using hot-dip galvanized malleable iron straps with nesting backs.
	Conduit entering boxes shall be terminated with a threaded hub with a grounding bushing.
	Galvanic isolation.

Raceway Identification:	WW
Description:	Wireway and auxiliary gutter, flanged, oiltight type with hinged covers.
Compliance:	JIC EMP-1.
Minimum Size:	8-inch by 8-inch.
Finish:	Hot-dip galvanized after fabrication, inside and outside. Smooth finished surfaces. Paint with factory standard finish.
Application:	As indicated on the Drawings.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for furnishing, installation, and connection of labels, nameplates, and markers used to identify electrical system equipment and components.

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.02 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Nameplate Schedules.

PART 2 – PRODUCTS

2.01 EQUIPMENT NAMEPLATES

A. Provide nameplates on all new and Owner-furnished equipment.

B. Panel Nameplates (Major Equipment): For equipment such as switchgear, variable frequency drive (VFD) panels, motor starter panels, control panels, electrical equipment enclosures, disconnect switches, motors, and pumps, the nameplates shall be:

1. Located on the enclosure face.

2. Rectangular screw-on type with self-tapping 316 stainless steel screws.

3. Laminated phenolic plastic nameplate, 1.25-inch-tall, with white letters on black backgrounds. Length as required.

4. Lettering: 1/2-inch-high lettering for equipment name with 1/2-inch-high lettering for tag or equipment number.

5. Nameplate text shall include:

   a. Line 1: Descriptive name (e.g., “Secondary Clarifier 7 RAS Pump 1”).

   b. Line 2: Descriptive tag (e.g., “46P1801”).

C. Enclosure Nameplates (Minor Equipment): For equipment such as local control stations, instrument transmitters, analytical controllers, and terminal boxes, the nameplates shall be:

1. Located on the enclosure face.

2. Adhesive-backed, 1-inch-tall, laminated phenolic plastic nameplate with white letters on black backgrounds. Length as required.

3. Lettering: 3/8-inch-high lettering for descriptive tag.

4. Nameplate text shall include:

   a. Line 1: Descriptive name (e.g., “Secondary Clarifier 7 RAS Pump 1”).

   b. Line 2: Descriptive tag (e.g., “46FIT1801” or “46LCP1801”).

D. Component Nameplates – Panel Face: For component identification located on panel face under or near component, the nameplates shall be:

1. Adhesive-backed, 1/2-inch-tall, laminated phenolic plastic nameplate with white letters on black backgrounds. Length as required.

2. Lettering: 3/16-inch-high lettering.

E. Component Nameplates – Back of Face: For component identification located on or near component inside of enclosure, the nameplates shall be:

1. Adhesive-backed, 1/2-inch-tall, laminated phenolic plastic nameplate with white letters on black backgrounds. Length as required.

2. Lettering: 3/16-inch-high lettering.

F. Nameplate schedule shall be included with all equipment submittals.

2.02 WIRE MARKERS

A. Identify each power and control conductor at each end of each terminal to which it is connected. Include identification for each spare conductor.

B. Conductors size No. 10 AWG or smaller shall have identification sleeves:

1. Machine print on sleeves with permanent black ink the letters and numbers that identify each wire.

2. Figures: 1/8 inch high.

3. Sleeves: White tubing, sized to fit the conductor insulation.

4. The sleeves shall be shrunk to fit the conductor with hot air after installation.

5. Acceptable Manufacturer:

   a. TMS Thermofit Marker System by Raychem Co.

   b. Sleeve style wire marking system by W. H. Brady Co.

   c. Approved equal.

6. Adhesive strips are not acceptable.

C. Use cable markers of the locking tab type for conductors No. 8 AWG and larger:

1. Tabs: White plastic with conductor identification number permanently embossed.

2.03 RACEWAY NUMBERING SYSTEM

A. General:

1. Identify each conduit; rack and tray shall be identified by a unique number shown on the Drawings.

B. Conduit Identification Tag:

1. Pressure stamp conduit numbers into a non-corrosive metal tag. Fix a tag with number to each end of each conduit and at each manhole, pullbox, and handhole with Type 304 Stainless Steel wire.

PART 3 – EXECUTION

3.01 GENERAL

A. Label all new and Owner-furnished electrical and control equipment.

3.02 CONDUCTOR IDENTIFICATION

A. Identify each wire or cable at each termination and in each pull box, junction box, handhole, and manhole using numbered and lettered wire markers. All electrically-common conductors shall have the same number. Each electrically-different conductor shall be uniquely numbered. Identify panelboard circuits using the panelboard identification and circuit number. Identify motor control circuits using the equipment identification number assigned to the control. Identify other circuits as shown in the circuit schedule or as favorably reviewed by the Engineer.

B. Conductors between terminals of different numbers shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number.

C. Conductors No. 8 and smaller shall be identified by printed sleeve of the heat-shrink type. All such sleeves shall be shrunk to the conductor insulation.

D. Contractor is responsible to identify every termination at this site except for light switch and outlet terminations, whether Contractor terminated them or terminations were made by others.

E. It shall not be required to identify equipment ground wires except by green color.

3.03 SWITCH AND OUTLET BOXES

A. Label light switches and outlets with panel name and circuit number.

END OF SECTION

SECTION 26 05 73
POWER SYSTEM STUDIES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Provide the services of a recognized independent testing laboratory or coordination analysis consultant who is regularly engaged in power system studies to provide the following reports:

1. Short Circuit Report.

2. Protective Device Coordination Report.

3. Arc Flash Report.

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.02 SUBMITTALS

A. Procedures: As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Provide separate submittal for each project site/location.

C. Submit the name and the qualifications of the laboratory or consultant for review by the Engineer. Qualifications must include professional registration of proposed personnel as electrical engineers.

D. Certified Short Circuit, Coordination, and Arc Flash Reports: Submit prior to the start of manufacture of equipment included in the scope of the Short Circuit, Coordination, and Arc Flash Reports. Provide correction(s) to report(s) as necessary to accommodate changes to equipment configuration and/or components.

E. Arc flash warning labels: Submit no less than 6 weeks prior electrical equipment commissioning.

PART 2 – PRODUCTS

2.01 SHORT CIRCUIT, COORDINATION, AND ARC FLASH REPORTS

A. Scope of Effort:

1. Perform the studies using actual equipment data.

2. Short Circuit, Coordination, and Arc Flash Reports to be stamped and signed by an electrical Engineer registered in the State of Washington.

3. The reports shall include:

    a. All equipment shown on the one-line diagrams and the associated feeder breakers from Substation A. Include the existing utility service, standby generator source, Substation A utility and generator main circuit breakers as well as other electrical distribution system components which may be necessary to provide a complete short circuit, coordination, and arc flash report for this project.

B. Coordination Objective:

1. The protective device on the line side closest to the fault or abnormal conditions shall isolate the problem portion of the system and minimize damage in that portion. The rest of the system shall be maintained in normal service. The coordination shall be in conformance with the recommendations of latest IEEE Standard 242.

2. Use the circuit breaker manufacturer's selective coordination tables to determine coordination in the instantaneous trip region.

C. Report Submittals:

1. Schedule:

    a. Submit Short Circuit, Coordination, and Arc Flash Reports with equipment submittals.

    b. Provide and install arc flash labels prior to commissioning.

2. Submit the analysis, which shall include impedance and short-circuit calculations, list of any assumptions made in the analysis, the recommended settings of the protective devices, and the system time/current characteristic curves. The submittal shall be made so as to allow time for review and resubmittal, if necessary, before the implementation of final settings and adjustments by the testing laboratory.

3. Short Circuit Report: As a minimum, include the following in the report:

    a. Executive summary.

    b. Equipment manufacturer's information used to prepare the study.

    c. Assumptions made during the study.

    d. Short circuit calculations listing short circuit levels at each bus.

    e. Evaluation of the electrical power system and the model numbers and settings of the protective devices associated with the system.

    f. Time-current curves including the instrument transformer ratios, model numbers of the protective relays, and the relay settings associated with each breaker.

    g. Comparison of short circuit duties of each bus to the interrupting capacity of the equipment connected to that bus.

4. Protective Device Coordination Report: As a minimum, include the following on 5-cycle, log-log graph paper:

    a. Time-current curve for each protective relay or fuse showing graphically that the settings will allow protection and selectively within Industry standards. Identify each curve and specify the tap and time dial setting.

    b. Time-current curves for each device to be positioned for maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, notify the Project Representative as to the cause.

    c. Time-current curves and points for cable and equipment damage.

    d. Circuit interrupting, device operating, and interrupting times.

    e. Indicate maximum fault values on the graph.

    f. Sketch of bus and breaker arrangement.

5. Arc Flash Report: As a minimum, include the following in the report:

    a. Equipment manufacturer's information used to prepare the study.

    b. Assumptions made during the study.

    c. Reduced copy of the one line Drawing.

    d. Arc flash evaluations summary spreadsheet including:

        1) Bus name.

        2) Upstream protective device name, type, settings.

        3) Bus line to line voltage.

        4) Bus bolted fault.

        5) Protective device bolted fault current.

        6) Arcing fault current.

        7) Protective device trip/delay time.

        8) Breaker opening time.

        9) Solidly grounded column.

        10) Equipment type.

        11) Gap.

12) Arc flash hazard protection boundary.

13) Working distances.

14) Incident energy.

15) Required protective fire rated clothing type and class.

e. Bus detail sheets.

f. Arc flash warning labels printed in color on adhesive-backed labels.

1) Arc flash warning labels are to be produced and attached to each piece of electrical equipment included in the scope of these reports.

2) These labels must indicate approach boundaries, incident energy level, and the minimum PPE that is required when servicing the equipment within the arc flash boundary.

3) Labels shall be installed by Contractor on associated equipment.

PART 3 – EXECUTION

3.01 GENERAL

A. Perform the studies in accordance with:

1. IEEE Standards 141, 242, and 1584.

2. NFPA 70E.

3. OSHA 29-CFR, Part 1910 Subpart S.

B. Perform the studies using actual equipment data.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. This section specifies panelboards for lighting and power distribution.

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.02 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Manufacturer’s data including:

1. Panelboard type and ratings.
2. Overall panelboard dimensions.
3. Lug size.
4. Bus material.
5. Breaker types, trip ratings and interrupt ratings.

C. Nameplate and Panel Schedule.

D. Operation and Maintenance information.

1.03 QUALITY ASSURANCE

A. Referenced Standards: This section incorporates by reference the latest revision of the following documents. These references are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
IBC	International Building Code – Seismic compliance requirements
NEMA PB 1	Panelboards
NEMA AB 1	Molded Case Circuit Breakers
NFPA 70	National Electrical Code (NEC)
UL 50	Enclosures for Electrical Equipment

Reference	Title
UL 67	Panelboards
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures

B. Source Quality Control: Listed and labeled by Underwriter's Laboratories, Inc. (UL) or ETL.

1.04 WARRANTY

A. The warranty shall include material, shipping costs, labor, and travel.

B. Provide a 1-year warranty from the Final Acceptance Date which includes material, labor, and travel.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURER:

A. The use of a manufacturer's name, model, size, or catalog number is for the sole purpose of establishing the standard of quality and general configuration desired.

B. The equipment provided shall be by one of the manufacturers listed below. Engineer listing of the manufacturers and models does not guarantee that these manufacturers comply with the Contract Documents. Comply with all requirements of the Contract Documents and demonstrate such through submittals, equipment, performance, and other requirements.

1. Square D.
2. Cutler Hammer.
3. Siemens.
4. Approved equal.

2.02 PANELBOARDS

A. Ratings: Voltage, current and short circuit ratings as shown on Drawings.

B. Arrangement and Construction:

1. Circuit breaker, dead front type, with bus bar construction.
2. Panel Front: Concealed trim clamps and hinges.
3. Locks: Flush with cylinder, tumbler-type with spring loaded door pulls.
4. Non-removable fronts with doors in the locked position.
5. Panelboard Locks: Keyed alike.

6. Gutter space on all sides of the breaker assembly to neatly connect and arrange incoming wiring.

7. Panelboard: Composed of individually-mounted circuit breakers designed to be removable without disturbing other breakers.

8. Mount a directory holder with clear plastic plate and metal frame on the inside of the door.

9. Each main and branch circuit breaker shall be equipped with the accessories necessary for locking the handle in the ON or OFF position.

C. Bus:

1. Tin-plated copper with current ratings as shown on the panelboard schedules, sized in accordance with UL 67.

2. Determine ratings by temperature rise test.

3. Minimum Size: 100 A.

4. Panel Fault Withstand Rating: Equal to the interrupting rating of the smallest circuit breaker in the panel.

5. Other Buses: Panelboards shall be provided with a separate ground bus and a full capacity neutral bus.

D. Circuit Breakers:

1. Circuit Breakers: Molded-case type provided for the current ratings and pole configurations specified on the panelboard schedule.

2. Rated 120/208 Vac and 120/240 Vac: Minimum interrupting current rating of 22,000 A (symmetrical) at 240 Vac.

3. Bolt-on Type.

4. Listed in accordance with UL 489 for the service specified.

5. Load Terminals: Solderless connectors.

6. No series rated devices.

E. Enclosure: Type 1 box and front.

F. Panelboard Finish:

1. Cabinet: Fabricated from hot-dip galvanized steel in accordance with UL 50.

2. Fronts: ANSI 61 – gray, baked enamel finish.

G. Nameplates: Provided in accordance with the requirements of Section 26 05 53, “Identification for Electrical Systems.”

PART 3 – EXECUTION

3.01 TESTING

A. Test for proper operation and function.

3.02 SCHEDULE

A. Panelboards are scheduled on the Drawings.

B. Type in the circuit description on the circuit directory or panelboard schedule.

END OF SECTION

SECTION 26 24 19
MOTOR CONTROL CENTERS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for furnishing, installation, and connection of motor control centers (MCCs).

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.03 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Submit Shop Drawings in compliance with pertinent provisions of Division 1 including:

1. Elementary control diagrams for each compartment/bucket.

2. Wiring and interconnection diagrams. Include diagram for VFDs, including all terminals requiring field connections.

3. Frontal elevation and dimension Drawings. Include provisions for future VFD as shown on Drawings. Where unit arrangement or wiring deviates in any way from that shown on the Drawings, provide a complete record and explanation of such deviations.

4. Top and bottom conduit entry locations.

5. Listing of ratings, sizes, and style of components, including bus work.

6. Nameplate listings.

7. Equipment Shop Drawings for items installed within the MCC.

8. Manufacturer’s product data.

C. Submit a spare parts list showing recommended parts and quantities, as well as complete ordering information for replacement components. Provide instruction books for special control devices and special equipment installed in the control center. Submit these to the Engineer prior to installation of the equipment.

D. Operation and Maintenance information.

E. Submit Factory Test Results: Field Test results and as-left settings for adjustable devices in typewritten form and, where applicable, per NETA standards.

1.04 WARRANTY

A. The MCCs and associated equipment shall be warranted for a period of not less than 2 years from the Physical Completion Date against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc. The warranty shall include material, shipping costs, labor, and travel.

PART 2 – PRODUCTS

2.01 GENERAL

A. Comply with the requirements of UL 845 and NEMA ICS-18.

B. Rating: 480 Vac, 3-phase, 3-wire, 60 Hz unless otherwise shown on the Drawings.

C. Provide individual units in MCC sized and rated as shown on the Drawings and specified herein. MCC shall be standard catalog equipment modified as shown on the Drawings or specified herein as normally manufactured by the manufacturer.

D. Shall be factory assembled, except for shipping splits.

E. Acceptable Manufacturers:

1. General Electric Evolution Series 9000. Contact Dykman Electric, Steve Lemmo, 206-900-1258.

2. No equal to match existing MCCs.

2.02 STRUCTURE AND CONSTRUCTION

A. Structure:

1. Motor control centers shall be made of No. 14 gage steel minimum, and each section shall be as specified on the Contract Drawings. The individual unit compartments shall be a minimum of 6 inches high unless otherwise shown on Drawings. There shall be 72 inches available for stacking starter units. Compartments shall have pan-type doors with a minimum of two quarter-turn hold-down latches; and neoprene gaskets.

2. A full height vertical wireway, 20-square-inch minimum, shall be provided for each vertical motor control center section. The wireway shall contain full height removable doors. Horizontal wireways shall be provided top and bottom, extending the length of motor control centers.

3. Bottom channel sills shall be mounted front and rear of the vertical sections extending the full length of the motor control center lineup. A removable lifting angle shall be mounted on top and shall extend the width of the motor control center lineup.

4. Motor Control Centers and related equipment shall be braced for Seismic Zone 4 as defined by the latest version of the Uniform Building Code, and accepted by the local inspecting authority.

B. Construction:

1. Motor control centers located indoors shall have NEMA 1, gasketed enclosures.

2. Feeder tap units less than 225 A shall be drawout plug-in construction with hardened, plated copper free-floating stabs and steel spring backups. The door shall have interference tabs which prevent door closure if unit is improperly installed. Units shall be latched in the position to assure proper bus contact. The unit disconnect device shall be interlocked to prevent removal or reinsertion of a unit when the disconnect is in the “ON” or “TRIPPED” positions.

3. Fusible switch or circuit breaker disconnect operators shall be capable of accommodating three padlocks for locking in the “OPEN” position.

4. Hardware for mounting future starter and feeder tap units shall be provided at compartments specified as “FUTURE.

C. Finish and Color:

1. Prime coated, baked enamel finish.

2. Paint finish shall be ANSI 61 and the dry film thickness shall be not less than 3 mils.

2.03 BUS

A. General: Bus shall be tin-plated copper with bolted connections between vertical and horizontal bus bars. Access for tightening these connections shall be from the front, without the need for tools on the rear of the connection. Insulated horizontal and vertical bus barriers shall be provided. Barriers shall be fabricated from high-strength, glass-filled polyester resin.

B. Horizontal Bus: Unless otherwise specified, the main horizontal bus shall be rated a minimum 600 A continuous.

C. Vertical Bus: Unless otherwise specified, the vertical bus shall be rated a minimum 600 A continuous.

D. Neutral Bus: Where specified, a neutral bus shall be provided. The neutral bus shall have the same rating as the main horizontal bus.

E. Ground Bus: A 1/4-inch by 2-inch copper ground bus shall be provided the full length of the motor control center. Ground bus shall be located at the bottom of the motor control center. Provide a lug to terminate a bare 4/0 AWG copper ground conductors at each end of the ground bus.

F. Units shall be fed as shown on Drawings.

2.04 WIRING

A. General: Motor control centers shall be provided with NEMA Class II, Type B wiring. All starter units shall have terminal blocks for control wiring. Terminal blocks shall be provided for power wiring for starters size 2 and smaller. Motor control centers shall be provided with all necessary interconnecting wiring and interlocking. When a control section, as described in this section, is specified on the Drawings or schedules, wire directly to the relays or programmable controller's input/output modules as part of the interconnecting wiring. Provide elementary and connection diagrams for each starter unit and an interconnection diagram for the entire motor control center. Attach polyester plastic protected connection diagram to inside of each unit door.

B. Power Wire: Power wire shall be copper 90 degrees C "MTW" insulated, sized to suit load; minimum power wire size shall be No. 12 AWG copper stranded.

C. Control Wire: Control wire shall be No. 16 AWG stranded copper wire, rated 90 degrees C and UL listed for panel wiring.

D. Terminations and Cable Connections:

1. Terminals: Control wiring shall be lugged with ring-tongue or locking spade crimp type terminals made from electrolytic copper, tin-plated.

2. Cable Connectors: Cable connectors for use with stranded copper wire, sizes No. 8 AWG to 1000 MCM, shall be UL listed. Dished conical washers shall be used for each bolted connection. Connectors shall be reusable and shall be rated for use with copper conductors. Incoming line and outgoing feeder compartments shall be provided with crimp type lugs, 3M, Burndy, or approved equal. Provide sufficient termination capacity to support parallel conductors where required.

2.05 MAIN AND FEEDER BRANCH CIRCUIT PROTECTION

A. General: Main and feeder tap units shall consist of fused disconnect switches or circuit breakers, as specified. The trip setting shall be adjustable from 700 to 1,300 percent of the motor full load amperes from the front of the breaker. The motor circuit protector shall be set at its lowest position at the factory.

B. Fused Disconnect Switches: Fused disconnect switches shall be equipped with visible knife blades, shielded line terminals, and a quick-make, quick-break switch operator. Fuse clips shall be UL Class R rejection type. Type RK-1 dual-element fuses shall be used for both motor and non-motor loads. Unless otherwise specified, assembly shall have a UL listed short circuit capacity of 65,000 A, symmetrical. Fuses shall be nonrenewable. Fuse removal shall be readily accomplished with the use of a fuse puller.

C. Circuit Breakers (thermal magnetic): Thermal-magnetic circuit breakers shall be molded case equipped with toggle type handle, quick-make, quick-break over center switching mechanism that is trip-free so that breaker cannot be held closed against short circuits and abnormal currents. The tripped position shall be clearly indicated by breaker handle maintaining a position between "ON" and "OFF." All poles shall open, close, and trip simultaneously. Minimum short circuit capacity shall be 65,000 A RMS symmetrical.

D. Circuit Breakers (with electronic trip unit). Minimum short circuit capacity shall be 65,000 A RMS symmetrical. Electronic trip unit shall provide the following features:

1. Solid state trip unit consisting of current sensors, logic assembly, magnetic latch release, and required interconnecting wiring.

2. Automatic and self-contained within the breaker frame and not requiring any external relaying or power supplies.

3. Tripping Functions: Field-adjustable and containing, as a minimum, the following tripping characteristics unless otherwise indicated on Drawings:

a. Overload Tripping:

1) Adjustable ampere setting.

2) Adjustable long-time delay.

b. Short Circuit Tripping:

1) Adjustable short-time pickup.

2) Adjustable short-time delay.

3) Adjustable instantaneous pickup.

c. Ground Fault Tripping:

1) Adjustable ampere setting.

2) Adjustable ground fault delay.

2.06 MOTOR CONTROLLER UNITS

A. General: Motor controller units shall be combination type with contactor and fused disconnect switch or motor circuit protector as specified on the Drawings or the MCC schedule. The starter units shall have a minimum combination UL listing of 65,000 A RMS, symmetrical or as specified in the schedule.

B. Fused Disconnect Switches: Fused disconnect switches shall be as specified in this section. Type RK-5 fuses shall be used for starter sizes 1 through 5. Class L time-delay fuses shall be used for Size 6. Unless otherwise specified, assembly shall have a UL listed short circuit capacity of 65,000 A symmetrical.

C. Motor Circuit Protectors: The molded case motor circuit protector shall operate on the magnetic principle with a current sensing coil in each of the three poles to provide an instantaneous trip for short circuit protection.

D. Provide motor controllers as follows:

1. Mounted in vertical position, gravity dropout.

2. Double break silver alloy contacts.

3. Solid State (Electronic) Overload Relay:

   a. Manual reset button.

   b. Visible trip indication.

   c. Use NEMA Class 20 adjustment for general applications.

   d. Use NEMA Class 10 adjustment for submersible pump motors.

   e. Provide communication module to transfer data on PLC communication network as shown on the Drawings.

   f. NEMA Size 1 minimum or as shown on the Drawings.

E. Control Transformers:

1. Each control transformer shall be rated 480/240–120 V, single-phase, 2-wire, 60 Hz. The transformer shall be sized for the load it feeds but shall not be less than the minimum ratings as follows:

NEMA Starter Size	Volt-Ampere Rating
1	100
2	150
3	200
4	300
5	500

2. Each control transformer shall be provided with time-delay, slow-blow secondary fuse rated to interrupt 10,000 A short circuit at 250 Vac. Two UL Class CC time-delay primary fuses rated to interrupt 200,000 A at 600 V shall be provided on all starters. Fuses shall be sized in accordance with NEC. Primary fuse shall have a time/current characteristic specifically designed for control circuit transformer protection.

3. Fuse holder for secondary fuse shall be drawout indicating type and mounted on the door of the compartment. Fuse holders for primary fuses shall be fuse clips with full barriers between fuses.

F. Overload Relay: The overload relay with Solid State elements shall protect the power wiring and motor from excessive overcurrents. The relay shall be ambient compensated and have adjustment from 90 to 110 percent of the normal heater rating. The sensing element shall conform to ANSI/NEMA ICS 2-222.06, Class 20 tripping time.

G. Terminal Blocks: Terminal blocks shall be screw type rated 600 V, 20 A for control wiring and 30 A power wiring (starters size 3 and larger shall terminate the power leads directly to the contactor). The number of terminal blocks shall be specified on the Drawings. Terminal blocks shall be provided with integral marking strips and shall be permanently marked with the conductor number as specified on the Drawings. Internal wiring shall be connected on one side of the terminal block; outgoing conductors shall be connected to the other side.

H. Provide motor control units with all push buttons, switches, indicating lights, and other devices as shown on the Drawings.

2.07 VARIABLE FREQUENCY MOTOR CONTROLLERS

A. Provide per Section 26 29 23.

2.08 SURGE PROTECTIVE DEVICES

A. Provide as shown on Drawings and per Section 26 43 00.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install MCC in accordance with manufacturer's recommendations.

B. Install the motor control center level and plumb, and secure to the existing 4-inch-high housekeeping concrete pad in conformance with the favorably reviewed seismic mounting method. The housekeeping pad shall be reinforced with steel which is tied or bolted to the structural floor, or the MCC mounting bolts shall pass through the housekeeping pad and embedded at least halfway into the structural floor. At least two 3/8-inch anchor bolts shall be installed at opposite corners of each MCC section, or each section corner shall be welded to 4-inch steel "C" channels embedded with "L" bolts in the top of the housekeeping pad. Doors shall swing freely and close tightly.

C. Bolt sections together to form a single unit. Torque all bus connection bolts and all section connection bolts.

D. Carefully repair any damage to the structure, components, or finish to the satisfaction of the Engineer. Clean nameplates.

E. Exercise care at times after installation of motor control center(s) to keep foreign matter, dust, dirt, debris, and moisture out of the control center(s).

F. Lace incoming and outgoing power conductors to resist short circuit forces. Follow manufacturer's instructions.

G. Seismic anchorage and bracing per Section 13 05 41.

3.02 FIELD TEST

A. Configure adjustable settings including, but not limited to, circuit breaker and MCP protection settings and motor overloads.

B. Test the motor control center(s) per ANSI/NETA ATS-2017 paragraph 7.16.2.1.

C. Submit test results and as-left settings in typewritten form and, where applicable, per NETA standards.

3.03 OWNER ORIENTATION AND TRAINING

A. A manufacturer's representative for the equipment specified herein shall be present at the jobsite or classroom designated by the Owner for the minimum person-days listed for the services herein under, travel time excluded:

   1. Two person-days during construction for installation assistance, inspection, and certification of the installation.

   2. One person-day for classroom or site training.

   3. Two person-days for functional testing and system startup.

B. Services shall be at such times as requested by the Owner.

C. The manufacturer's representative shall instruct the Contractor on the proper installation procedures at any time the representative and/or the Project Representative witness improper installation practices.

END OF SECTION

SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for furnishing, installation, and connection of junction boxes for consolidation of conduit runs, pull boxes to aid in pulling conductors, and outlet boxes for wiring devices, lighting fixtures, and signal equipment.

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.02 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.

B. Shop Drawings and product data.

PART 2 – PRODUCTS

2.01 OUTLET BOXES

A. Sheet Metal Boxes:

1. Sheet metal boxes shall conform to UL 50, with a hot-dipped galvanized finish conforming to ASTM A123.

2. Outlet boxes and switch boxes shall be designed for mounting flush wiring devices. Boxes and box-extension rings shall be provided with knockouts. Boxes shall be formed in one piece from carbon steel sheets. Outlet boxes shall not be less than 4 inches square and 1-1/2 inches deep.

3. Ceiling boxes shall withstand a vertical force of 200 pounds for 5 minutes.

4. Wall boxes shall withstand a vertical downward force of 50 pounds for 5 minutes.

5. Gangable and through-wall types are not acceptable.

6. Boxes shall conform to FS W-J-800D and UL 514A and UL 514C.

B. Cast Metal Boxes:

1. Box bodies and cover shall be cast or malleable iron with a minimum wall thickness of 1/8 inch at every point, and not less than 1/4 inch at tapped holes for rigid conduit. Bosses are not acceptable.

2. Mounting lugs shall be provided at the back or bottom corners of the body.

3. Covers shall be secured to the box body with No. 6 or larger brass or bronze flathead screws.

4. Boxes shall be provided with neoprene cover gaskets.

5. Where only cast aluminum is available for certain types of fixture boxes, an epoxy finish shall be provided.

6. Outlet boxes shall be of the FS types. Boxes shall conform to FS W-C-586C, UL 514A, and UL 514C.

2.02 TERMINAL CABINETS:

A. Terminal cabinets located indoors shall be NEMA 4.

B. Cabinets located outdoors and in corrosive areas shall be NEMA 4X, stainless steel.

C. Cabinets shall be provided with hinged doors.

D. Adjustable terminal strip mounting accessories shall be provided.

E. Cabinets shall be provided with channel mounted terminal blocks rated 30 A, 600 Vac.

F. Terminals shall be No. 8 minimum strap-screw type, suitable for ring tongue or locking spade terminals.

2.03 ENCLOSURES

A. Unless otherwise noted, provide enclosures as follows:

1. Dry Locations: NEMA Type 1.

2. Wet Locations (outdoor, non-hose down): NEMA Type 4X, stainless steel.

3. Wet Locations (subject to hose down, chemical storage, and loading areas): NEMA Type 4 or better.

4. General Process Areas (subject to hose down): NEMA Type 4 or better for equipment installed at or below 6 feet above finished floor, NEMA Type 12 or better for equipment installed higher than 6 feet above finished floor.

5. Damp Locations: NEMA Type 12.

6. Corrosive Locations: NEMA Type 4X, Stainless Steel.

7. Hose down locations include those locations likely to be cleaned or washed during normal operations. These locations include chemical storage and loading areas and other areas where hose bibs are installed to facilitate hose down.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide fixture outlets with proper fixture connectors.

B. Box mounting height shall be dictated by the wiring device enclosed.

C. Blanking covers shall be installed on all unused openings.

D. Sheet metal boxes shall be used in dry noncorrosive locations where the conduit system is routed concealed in the walls and ceilings.

E. Cast metal or molded nonmetallic surface-mounted boxes shall be used in exterior and/or in all wet locations.

F. Bonding jumpers shall be used around all concentric or eccentric knockouts.

G. Boxes shall be securely mounted to the building structure independent of conduits entering or exiting the boxes.

H. No top conduit entry for outdoor enclosures, damp or wet locations, or for NEMA 3R, 4 and 4X enclosures.

I. Provide nameplates and labels for cabinets and enclosures.

J. Grounding of cabinets and enclosures shall comply with the NEC.

K. Anchorage and bracing per Section 13 05 41.

END OF SECTION

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SECTION 26 27 26
WIRING DEVICES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for furnishing, installation, and connection of:

1. Single, duplex, GFI, and special purpose receptacles complete with wall plates and/or covers.

2. Single-pole, three-way, pilot lights, and momentary position toggle switches complete with wall plates and/or handle operators.

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.02 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Shop drawings and product data.

PART 2 – PRODUCTS

2.01 RECEPTACLES

A. General: Receptacles shall be specification grade, heavy-duty, high-abuse, grounding type conforming to NEMA configurations, NEMA WD1, and UL 498 Standards.

B. Single and Duplex Receptacles:

1. Receptacles shall be of back and side wire design utilizing screw-type terminals. Receptacles shall be rated 20 A, two-pole, three-wire, 120 V, NEMA 5-20 configuration, self-grounding. Color shall be brown in industrial areas and ivory or white in office and laboratory areas. Power contacts shall be a T-type design and shall be brass. Ground contacts shall be brass.

2. Devices shall have a nylon composition face with a nylon or melamine body. Units shall comply with Federal Specification W-C-596E and meet UL 498 test requirements. Receptacles shall be Hubbell HBL5362, or approved equal.

C. Special Purpose Receptacles: Receptacles shall be of the amperage, voltage, and NEMA configuration indicated on the Drawings. Compliance to standards and tests shall be as listed in Item B above.

D. GFI Receptacles:

1. Device shall be rated 20 A, two-pole, three-wire, 120 V, conforming to NEMA WD1.10 configuration. Face shall be nylon composition meeting UL 498 test standards. Unit shall have test and reset push buttons and LED indicator.

2. GFCI component shall meet UL 943 Class A standards with a tripping time of 1/40 second at 5 mA current unbalance. Operating range shall extend from 31 degrees F to 158 degrees F. Unit shall have transient voltage protection and shall be ceramic encapsulated for protection against moisture.

3. Provide Hubbell GF20 or approved equal.

E. Surface Multiple-Outlet Assemblies: Units shall have outlets on center-to-center spacing as indicated on the Drawings. Assembly shall conform to Article 353 of the NEC and receptacles shall conform to the standards listed in Item A above.

2.02 SWITCHES

A. Line-Voltage Types: Switches shall be rated 20 A at 120 V or 277 V, ac only. Units shall be flush-mounted, self-grounding, quiet-operating toggle devices. Handle color shall be brown in industrial areas and white or ivory in office and laboratory areas. Units shall conform to Federal Specifications W-S-896 D and E, UL 20-11 and UL 20-2, and NEMA WD1 Standards. Hubbell HBL1221 or approved equal.

B. Low-Voltage Types: Switches shall meet all of the requirements listed in Item A above except to be rated at 15 A for switching 24 Vdc. Devices shall be three-position, momentary-contact, spring-return, center “off” configuration.

C. Manual Motor Starters: For 120 V, single-phase motors that require a lockable disconnect, provide a padlockable manual motor starter without overloads.

2.03 PLATES AND COVERS

A. General: Plates shall be of the style and color to match the wiring devices, and of the required number of gangs. Plates shall conform with NEMA WD1, UL 514, and ANSI C73. Plates on finished walls shall be nonmetallic or stainless steel. Plates on unfinished walls and on fittings shall be of zinc-plated steel or cast metal having rounded corners and beveled edges.

B. Nonmetallic: Plates shall be smooth finish with contoured edges and shall be nylon or fiberglass.

C. Stainless Steel: Plates shall be 0.035 inches thick with beveled edges and shall be manufactured from No. 302 alloy having a brushed or satin finish.

D. Galvanized: Plates shall be galvanized sheet steel raised 1/2 inch, with rounded corners.

E. Cast Metal: Plates shall be cast or malleable iron covers with gaskets so as to be moisture resistant or weatherproof.

F. Blank Plates: Cover plates for future telephone or television outlets shall match adjacent device wall plates in appearance.

G. Damp or Wet and Corrosive Locations: Plates shall have weather protective double doors. Material of manufacture shall be die-cast aluminum for metallic plates or nylon for nonmetallic plates.

H. Outdoor Locations: While-in-use style weatherproof cover, cast metal while-in-use cover, padlockable in the closed position, Hubbell or approved equal.

PART 3 – EXECUTION

3.01 INSTALLATION OF WIRING DEVICES

A. Dry Locations: The device shall be installed in flush-mounted boxes with washers as required to bring the device mounting strap level with the surface of the finished wall.

B. Damp or Wet Exterior Locations: Install only wiring devices approved for outdoor service in these locations.

C. Mounting Heights:

1. Locations of wall outlets shall be measured from the finished floor to the center of the outlet box. Boxes shall be adjusted so that the front edge of the box shall not be further back from the finished wall plane than 1/4 inch. Boxes shall be adjusted so that they do not project beyond the finished wall. Height above finished floor shall be as follows:

    a. Telephone Outlets – Office Areas: 12 inches from floor.

    b. Telephone Outlets – Industrial Areas: 60 inches from floor.

    c. Duplex Receptacles – Office Areas: 12 inches from floor.

    d. Receptacles – Industrial Areas: 46 inches from floor.

    e. Toggle Switches: 46 inches from floor.

    f. Clock Outlets: 84 inches from floor.

D. Damp or Wet Interior Locations:

1. Install only wiring devices approved for outdoor service.

2. Adjust boxes so that front edge will be 1/4 inch beyond the rear edge of the finished wall.

3. Use metal tubing sleeves to bring device-mounting straps flush with the front edge of the finished wall.

E. Receptacles:

1. Receptacles shall be grounded by a grounding conductor, not by a yoke or screw contact.

2. Receptacles shall be oriented so that the grounding slot is located at the top of the outlet.

3. Receptacles shall be installed with connections pigtailed (spliced) to the branch circuit wiring so that removal of the receptacle will not lose neutral continuity and branch circuit power will not be lost to other receptacles on the same circuit.

3.02 INSTALLATION OF WALL PLATES

A. General: Plates shall match the style of the device and shall be plumb within 1/16 inch of the vertical or horizontal.

B. Interior Dry Locations: Install plates so that all four edges are in continuous contact with the finished wall surfaces. Plaster filling will not be permitted. Do not use oversize plates or sectional plates.

C. Exterior and/or Wet Locations: Install plates with gaskets on wiring devices in such a manner as to provide a rain-tight weatherproof installation. Cover type shall match box type.

D. Future Locations: Install blanking cover plates on all unused outlets.

3.03 TESTS

A. Receptacles:

1. Receptacles shall be tested for blade and ground-plug tension prior to installation. Do not install any receptacle having less than 16-ounce individual blade retention.

2. After installation of receptacles, circuits shall be energized and each receptacle tested for proper ground continuity, reversed polarity, and/or open neutral condition.

B. GFI receptacles shall be tested with the circuits energized. Devices shall be tested with a portable GFI receptacle tester capable of circulating 7.5 mA of current, when plugged in, between the “hot” line and “ground” to produce tripping of the receptacle. Resetting and tripping shall be checked at least twice at each GFI receptacle.

END OF SECTION

SECTION 26 28 00

LOW-VOLTAGE CIRCUIT PROTECTIVE DEVICES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for furnishing, installation, and connection of overcurrent protective devices.

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.03 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Shop Drawings and product data.

PART 2 – PRODUCTS

2.01 FUSES

A. General purpose fuses for protection of motors, transformers, feeders, and main service:

1. Use UL Class RK-1 Fuses:

a. Single end rejection or to fit mountings specified.

b. 0 to 600 A rating.

c. 200,000 A interrupting capacity.

d. Dual element, time delay.

e. Use Bussman Low Peak LPN-RK, or approved equal: 250 V rating.

f. Use Bussman Low Peak LPS-RK, or approved equal: 600 V rating.

2. Use UL Class L Fuses:

a. Bolt-in type.

b. 601 to 6,000 A rating.

c. 200,000 A interrupting capacity.

d. Time delay.

e. Use Bussman HI-CAP, KRP-C, or approved equal: 600 V rating.

B. General purpose fuses for protection of motor control circuits, lighting ballasts, control transformers, and street lighting fixtures:

1. Use UL Class CC, fast acting, single element fuses.

2. Rated for 0 to 30 A.

3. Provide 200,000 A interrupting capacity.

4. Use Bussman Limitron KTK-R, or approved equal: 600 V rating.

2.02 MOLDED CASE CIRCUIT BREAKERS

A. General:

1. Comply with UL 489 requirements.

2. Provide thermal and magnetic protection.

B. Provide permanent trip lighting panel circuit breakers as follows:

1. UL listed SWD (switching duty) on 120 V circuits where switched circuits are indicated.

2. Short circuit rating (integrated equipment rating):

a. Up to 240 V: 10,000 RMS symmetrical amps minimum.

b. Up to 480 V: 14,000 RMS symmetrical amps minimum.

C. Where enclosed circuit breakers are required, provide with:

1. Cover interlock.

2. Handle position that indicates ON, OFF, or TRIPPED.

3. Padlock provision in the OFF position.

4. External trip indication.

5. Provision for insulated or bonded neutral.

6. Provision for control circuit interlock.

2.03 SAFETY DISCONNECT SWITCHES

A. Disconnect switches shall be heavy-duty, quick-make/quick-break type safety switches with the voltage ratings, current ratings, and number of poles as indicated on the Drawings. The switches shall be 600 Vac and horsepower rated. Provided with:

1. Cover interlock mechanism with handle attached to box:

    a. Handle position indication of ON in up position and OFF in down position.

2. Padlock provision in the ON and OFF positions.

3. Provisions for insulated or bonded neutral.

4. Provision for control circuit interlock.

2.04 ENCLOSURES

A. Indoor: Provide NEMA 1 steel construction.

B. Outdoor area: Provide NEMA 4X stainless steel construction.

C. Corrosive area: Provide NEMA 4X stainless steel construction.

D. Hazardous area: Provide NEMA 7/9 cast iron or copper free cast aluminum alloy.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install overcurrent protective devices in accordance with manufacturer's recommendations.

B. Grounding of safety disconnect switches shall comply with the NEC.

3.02 ADJUSTMENT

A. Set and record adjustable settings on circuit breakers to provide selective coordination and proper operation.

END OF SECTION

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SECTION 26 29 23

VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for furnishing, installation, and connection of Variable Frequency Drives (VFDs).

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.02 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Include VFD submittal with MCC submittal where VFDs are installed inside MCC sections.

C. Catalog Cut Sheets and technical data indicating the equipment meets the specifications. Include VFD nameplate data.

D. Installation instructions, outline dimensions and weights including filters and/or isolation transformers, front view Drawing identifying control and monitoring devices, nameplate engravings, shipping section dimensions, weight, and foundation requirements or wall mounting requirements for all assemblies.

E. External connection diagram showing function and identification of all terminals requiring field connections:

1. The connection diagram shall include a control schematic which shows the connections and associated wiring necessary between the VFDs for the VFD Run Interlock specified in this section. The VFDs shall be configured with a hardwired run interlock which prevents both VFDs from running their respective pumps at the same time.

2. Verify that it shall not be possible for an Operator using the local VFD controls on the front of the VFD to over-ride the run interlock.

F. Schematics and wiring diagrams.

G. Plan Drawings showing conduit entry locations.

H. Manufacturer’s certification that the controller can withstand fault conditions based on the calculated available fault current.

I. Calculations of cooling and ventilation requirements.

J. Efficiency and Power Factor Calculations:

1. Calculate efficiencies of the VFD controller including the auto-transformer (where applicable), ventilation fans, control power, and all VFD losses.

2. Calculate displacement and total power factor including filter.

3. Perform calculations at 100, 75, and 50 percent speed.

4. Include first 36 harmonics.

K. Provide letters of certification from:

1. The VFD manufacturer and the motor manufacturer that the specific application has been reviewed and that the motor and drive combination will satisfy the torque and drive requirements under all conditions of operation and that VFD high voltage ringing on motor cables will not be detrimental to the motors.

2. The VFD manufacturer and the packaged blower manufacturer that the specific application has been reviewed and that the motor and drive combination will satisfy the torque and drive requirements under all conditions of operation.

L. Certified final factory test procedure and results for each drive.

M. Location and description of service center and spare parts stock.

N. Recommended spare parts list.

O. Certified copies of all material test reports.

P. Manufacturer's certificate of proper installation.

Q. Training schedule and materials.

R. Test instruments used to perform factory testing, including documentation of calibration.

S. Field testing procedures.

T. Test documentation from post installation field testing.

U. Operations and maintenance manuals.

V. Warranty information.

W. Hard copy and electronic copy (CD) of final VFD configuration parameters.

1.03 WARRANTY

A. Minimum warranty period (parts and labor) shall be 2 years following the date of substantial completion.

B. Warranty shall be comprehensive; no deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

1.04 COORDINATION

A. Motor:

1. Obtain and review the appropriate data for the driven motor and load with service factor over the required speed and torque range for a complete system analysis. Reference equipment sections for specific motor loads. Determine the size of the VFD required for the driven load and submit data to substantiate the sizing determination. It is the manufacturer's responsibility to provide drives sized for continuous operation of the driven equipment at full load.

2. Verify the type of VFD required for the driven load type, such as variable or constant torque design. The aeration blowers on this project are positive displacement and require constant torque VFDs.

3. Verify that equipment is mutually compatible and free of resonance over the complete operating range. Coordinate the assignment of any critical frequencies with the equipment suppliers specified in other divisions.

4. Coordinate the assignment of any critical frequencies with the motor supplier.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide integrated, all solid state, VFDs. Provide all additional components necessary to meet IEEE 519 as described below.

B. Factory install the control devices (push buttons and indicating lights shown on the Drawings) on the door of the VFD enclosure.

C. Factory install all control and monitoring devices shown on the Drawings or specified herein. Include all wiring, interior and field terminals required for the complete installation. Fieldwork shall be limited to landing field wire and cable on factory-wired field terminals.

2.02 MANUFACTURERS

A. Yaskawa. Contact Dykman Electric, Steve Lemmo, 206-900-1258.

B. No equal.

2.03 SERVICE CONDITIONS

A. Indoor location with a temperature range of 0 degrees F to 104 degrees F.

B. Seismic Requirements: The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the Uniform Building Code (UBC) for Seismic Zone 4 applications. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical- and lateral-required-response spectra as specified in above codes.

2.04 PERFORMANCE REQUIREMENTS

A. Performance:

1. Efficiency: Shall be above 95 percent at 100 percent full speed and full load.

2. Duty Cycle: At least six starts per hour.

3. Speed Range: 34 percent to 100 percent full speed, with adjustable minimum and maximum speeds. Provide speed limiting using either maximum torque or current control.

4. Power Factor: Above 0.95 at any operating speed.

5. Linearity and repeatability accuracy of three-phase output of 1 percent of analog input control signal regardless of input power voltage fluctuations between 437 V and 505 V.

6. VFDs shall meet all requirements as outlined in the current edition of IEEE 519 for each individual and total harmonic voltage distortion and as indicated in this specification. As per Table 10.2 of IEEE 519 (1992), individual or simultaneous operation of the VFDs shall not add more than 3 percent total harmonic voltage distortion while operating at full load and speed from the utility source, or more than 5 percent while operating from standby generator. For the purpose of this specification, the point of common coupling (PCC) shall be located at the automatic transfer switch. Calculations shall be based on 100 percent loading with all motors operating at the same time. Utility transformer size and impedance data shown on Electrical One-Line Diagram Drawing.

7. For systems with a standby generator, the harmonic distortion shall meet the distortion levels shown in Table 10.3 of IEEE 519-1992 for ISC/IL<20. The Contractor shall provide the following data for the standby generator in order to perform the calculations: Voltage, kW, kVA, and Subtransient Reactance (X″d), and total maximum demand ampere load for generator operation.

8. A harmonic analysis of the system shall be made consisting of the current and voltage harmonics expected from the addition of the adjustable frequency drives and active harmonic filters for all harmonics through the 25th per Tables 10-2 and 10-3 of IEEE 519-1992. This analysis shall be included as part of the bid submittal. If IEEE 519 requirements cannot be met, either an 18-pulse rectifier with an integral pre-wired phase shifting transformer for each drive or an active harmonic conditioner (filter) for the project shall be required as part of this specification.

2.05 VFD CONSTRUCTION DETAILS

A. General: Provide integrated, all solid state VFDs complete with all additional equipment to meet IEEE 519.

B. Operation: Accomplish speed control by adjusting the output frequency and voltage according to the desired reference speed. Adjust ac voltage and frequency simultaneously to provide the constant volts/Hertz necessary to operate the motor at the desired speed. The VFD must use pulse width modulation (PWM) technology.

C. Rating:

1. Line Voltage: 480 V plus or minus 10 percent continuous, plus 15 percent or minus 40 percent momentary (plus or minus 20 percent possible on generator).

2. Line Frequency: 60 Hz plus or minus 2 Hz.

3. Variable Torque Application: The drive shall be capable of delivering 110 percent motor torque overload capacity for 60 seconds in any one incident and up to 240 total seconds per hour.

4. Constant Torque Application: The drive shall be capable of delivering 150 percent motor torque overload capacity for 60 seconds in any one incident and up to 240 total seconds per hour.

5. VFD Motor Current: The VFD shall be capable of supplying continuous full load motor at maximum service factor.

6. No VFD regeneration capability.

D. Size: Coordinate dimensions to ensure conformance with the NEC “6-foot-7-inch” rule (2005 NEC 404-8).

E. Construction:

1. VFDs shall be mounted in MCCs and free-standing enclosures. See Drawings.

2. Each drive shall be housed in a single enclosure.

3. The enclosure shall be dead-front and dead-back construction with all modules, components, load, line, and control terminations fully front accessible. Rear access shall not be required. The VFD shall be designed and arranged to:

   a. Allow side-by-side mounting with equipment as shown on Drawings.

   b. Provide necessary clearances for all operation and maintenance activities both within and external to the enclosure.

   c. Provide straight-forward, non-congested maintenance access to components. It shall not be acceptable to require significant disassembly in order to access components for repair, test, or replacement.

4. Enclosure shall include provision for bottom entry of wiring and conduits. Submittals shall show conduit entry locations.

5. Enclosure door shall open a full 90 degrees under all conditions, including when other equipment is installed adjacent to enclosure sides.

6. Enclosure shall be equipped with three-point door-latching mechanism operated by a key-locking handle.

7. The VFD shall include an externally operated incoming line circuit breaker sized per NEC 430, Part III. The external operating handle shall be equipped with a mechanical interlock to prevent opening of the door when the breaker is in the ON position. The mechanical interlock shall be equipped with a defeater mechanism for use by authorized personnel. The external operating handle shall include provisions for a user padlock in both the open and closed positions.

8. Provide an operator interface on the front door. The operator interface shall consist of an electronic keypad and liquid crystal display (LCD) assembly capable of providing a complete operator interface for all VFD monitoring and control functions. The user interface shall include, but not be limited to, the following capabilities:

    a. “Power On” indication.

    b. “Local-Off-Remote” selector.

    c. Manual speed control.

    d. Speed indicator calibrated in percent of full speed.

    e. “Motor Run” indication.

    f. “VFD Fault” indication.

    g. “Cabinet Overheat” indicating light or keypad display “Drive Overtemp Fault.”

    h. Elapsed time that the VFD has been in use.

    i. Access to all VFD operating and diagnostic information.

    j. Access to all VFD programmable parameters.

F. Features:

1. Provisions to accept the following control signals for automatic and manual operation:

    a. “Run” and “Fault Reset” signal from a single remote contact closure.

    b. A 4–20 mA dc signal for speed control. The VFD shall provide linear speed control of the motor from minimum speed to maximum speed as the adjustable speed input signal varies from its minimum to maximum. Input impedance shall be 250 or 500 ohms resistive.

    c. Remote speed control potentiometer from the Main Control Panel. The VFD shall provide linear speed control of the motor from minimum speed to maximum speed as the adjustable speed input signal varies from its minimum to maximum.

2. Provide 4–20 mA output signal for:

    a. VFD Speed (rpm).

    b. Motor Current (amps).

3. Provide field-replaceable interposing relays with two dry, Form C, contacts for remote indication or interlocking as shown on the Drawings.

4. Motor current limit adjustable from 20 percent to 120 percent of motor full-load current. The initial current limit setting shall be 110 percent of motor full-load current.

5. Project control voltage is 120 Vac except where otherwise indicated. All control interfaces between the VFD and the external control system shall be compatible with the project control voltage.

6. VFD shall provide all internal voltage requirements.

7. The VFD shall be programmed for automatic restart attempts, 0 to 9 attempts, on selected trips. There shall be a programmable delay after fault recovery before the restart occurs adjustable between 1 and 300 seconds. The selectable auto reset trips shall include:

    a. Under voltage.

    b. Over current.

8. The VFD shall provide automatic restart after power failure.

9. The VFD shall be programmable such that if the maximum full-load current is exceeded, then after an operator programmable delay (0 to 300 seconds, initially 10 seconds), the frequency (speed) will automatically decrease until the running current does not exceed full-load current.

10. Provision for automatic emergency shutdown in any mode, actuated by the following:

    a. Emergency stop input via dry contact closure from external source.

11. VFD operable with motor disconnected in order to test VFD.

12. Independent acceleration and deceleration controls, adjustable from 0.1 to 30 Hz per second.

13. Critical frequency lockout over a minimum of three bands. All bands shall be independently adjustable over the operating range of the VFD.

14. User adjustable carrier frequency to minimize motor noise.

15. Provide an Ethernet TCP/IP communications port, minimum 100 megahertz for intercommunication with VFDs, PLC, and SCADA system.

G. Flying Start: The VFD shall be capable of determining the speed and direction of a spinning motor and adjust its output to “pick-up” the motor at the rotation speed. The flying start feature shall be operable without encoder feedback.

H. Protection:

1. Provide Class 10 motor overload protection that complies with NEC Article 430. Overload protection to be speed sensitive.

2. Protect VFD against the following conditions:

a. Reverse phase sequence and single phasing of input power.

b. Input power failure.

c. Input transient voltages, including peak suppression and snubbers, in accordance with ANSI C37.90.

d. Radio and television interference, including wireless hoist remote control.

e. Output over current.

f. Cabinet over temperature.

g. Voltage Dip: VFD shall be capable of sustaining continued operation with a 40 percent dip in nominal line voltage. Output speed may decline only if current limit rating of VFD is exceeded.

h. Power Loss:

1) VFD shall be capable of a minimum five cycle power loss ride-through at 75 percent full load without fault activation.

2) VFD shall provide automatic restart after power failure.

i. Undervoltage: VFD shall automatically shut down if input voltage falls below 414 V with automatic restart upon return to a stable 437 V or more.

j. Protect maintenance personnel from arc flash while working on control circuitry (120 Vac).

I. Motor Protection Relay:

1. Provide and install a motor protection relay suitable for the motor winding temperature and motor leak protection as shown on the Drawings. If the motor protection relay is not provided by the motor starter/VFD manufacturer integral with the MCC but is furnished separately by the equipment supplier, install the relay in a dedicated unit space of the MCC or in a junction box and wire as directed by the relay manufacturer.

J. VFD Programming: The VFD supplier shall perform all configuration and programming of VFDs as required by the project and as directed by the Contractor and Engineer.

K. Wire Numbering: All internal drive wiring shall be numbered. The wire numbers shall be shown on the VFD Drawings showing internal schematics and wiring diagrams.

L. Spare Parts:

1. The main logic board, keypad, and power supply board shall be supplied as spares, one for each different part number supplied.

2. Furnish two sets of spare power fuses for each size and type of fuse used.

3. Furnish a minimum of five fuses of each size and type of control circuit fuse.

4. Provide one spare printed circuit board for each different board in each size VFD supplied.

2.06 FACTORY TEST

A. A full-load standard factory burn-in test shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL, NEMA, and NETA Acceptance Testing (ATS) Standards.

B. All final assemblies shall be tested with application of line-to-line and line-to-ground bolted faults. The VFD shall trip electronically without device failure.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Install equipment level and plumb and anchor on foundations in accordance with the equipment manufacturer's instructions and as indicated herein.

C. Provide new 4-inch house cleaning pads under the VFD enclosures.

D. Embed anchor bolts in concrete floor. Use no less than four for each equipment assembly. Anchor sills to floor slab. If a concrete pad is used, anchor bolts shall extend through the new pad to attach to equipment frame of the VFD. If Unistrut is used, anchor it to the floor independently.

E. Provide earthquake resistant attachments and supports for equipment.

F. The Contractor shall provide written verification to the Owner Representative that the factory installed wiring, busing, metering, relaying, and related equipment are properly connected, aligned, phased, and identified.

G. Seismic anchorage and bracing per Section 13 05 41.

3.02 FIELD TESTING

A. Provide a minimum of two site visits and a minimum of 16 hours of services at the job site by a factory-trained service technician to certify installation, make final adjustments to equipment, and carry out operational testing in the presence of the Engineer. Testing to

include checks for all fault parameters, all normal operational indications, permissives, interlocks, operational sequences, back-up sequences, remote and local controls, alarm logging, and start-up modes.

B. Replace any failed or damaged parts at no cost to Owner.

C. Following installation and manufacturer's field test, perform a field test under utility and standby operating conditions. Operate the VFD(s) from no load to full load.

3.03 TRAINING

A. Service technician shall provide a minimum of 8 hours of on-site training to instruct operating personnel in the operation, maintenance, and adjustment of the system and installation.

END OF SECTION

SECTION 26 43 00
SURGE PROTECTIVE DEVICES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for furnishing, installation, and connection of Surge Protective Devices (SPDs).

B. Refer to Section 26 05 00, “Common Work Results for Electrical,” for quality assurance, submittal procedures, and other requirements.

1.02 SUBMITTALS

A. As specified in Section 26 05 00, “Common Work Results for Electrical.”

B. Complete Drawings and documentation shall be provided by the motor controller manufacturer and shall include:

1. Catalog cut sheets

2. Dimension and outline Drawings.

3. Nameplate schedule.

C. Operation and maintenance manuals.

1.03 WARRANTY

A. Provide a 1-year warranty from the Final Acceptance Date which includes material, shipping costs, labor, and travel.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. General:

1. An integrally mounted SPD system shall be included for the protection of all AC circuits from the effects of lightning induced currents, substation switching transients, and internally generated transients resulting from inductive and/or capacitive load switching.

2. Rated for use at service entrance.

3. Modular with the following features:

    a. Suppression Element: Each to be metal oxide varistor (MOV) based and have each phase fused with fuses sized to accommodate surge current rating.

    b. Surge Current Diversion Paths:

        1) Provided between each phase conductor and neutral, between each phase conductor and ground and between the neutral conductor and ground.

        2) For Delta Configured Systems: Having components connected between each phase conductor and between each phase conductor and ground. Copper bus bars incorporated for the surge current path.

        3) Do not use plug-in connections and round wire in the surge current path.

        4) Directly connected to the bus bars of the switchgear, MCC, or panelboard to provide a low impedance surge current path.

    c. Provide UL-approved disconnect switch as a means of disconnect.

    d. Event Surge Counter:

        1) Mounted on the dead front of the panelboard.

        2) Containing battery to retain memory during power outages.

        3) Equipped with a manual reset push button.

    e. Equip with Visual and Audible Diagnostic Monitoring:

        1) Indicating Lights: To provide full-time monitoring of each phase of the surge current diversion module.

        2) Alarm: Activates upon a fault condition and has acknowledge, test, and reset push buttons.

        3) Form C Dry Contacts: One set which change state during an alarm condition to be provided.

        4) Alarm Contacts: Remain in alarm condition until the fault has cleared and the alarm has been manually reset.

4. Meets or exceeds the following criteria:

    a. Surge current rating of at least 250 kAIC per phase.

    b. Capable of surviving 5,000 ANSI/IEEE C62.41 Category C3 transients without failure or degradation of UL 1449 Suppression Voltage Rating by more than 10 percent.

c. Designed to withstand a continuous operating voltage of not less than 115 percent of nominal RMS voltage.

d. Has a minimum EMI/RFI filtering of -50 dB at 100 kHz with an insertion ratio of 50:1 using MIL STD. 220A methodology.

e. Has a response time no greater than 1/2 nanosecond for any of the individual protection modes.

f. Recognized Component Suppression Voltage Ratings: Not to exceed the requirements of UL 1449.

g. Category C3 Let Through Voltages: Not to exceed the requirements of ANSI/IEEE C62.41.

B. Acceptable Manufacturers:

1. SPDs shall be provided by the MCC manufacturer.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installed per the manufacturer's specifications.

END OF SECTION

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Division 40

Process Interconnections

SECTION 40 61 13

PROCESS CONTROL SYSTEM GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Work Included:

1. Provide necessary tools, equipment, materials, supplies and labor required to complete the installation, startup, and operational testing of a complete and operable Process Instrumentation and Control (I&C) System as indicated on the Drawings and as specified herein.

2. Provide the necessary equipment components and interconnections along with the services of manufacturers' engineering representatives necessary to ensure that the Owner receives a completely integrated and operational Process I&C system as herein specified.

3. Provide all terminations for wiring at field mounted equipment, equipment enclosures, alarm, and status contacts.

4. Provide necessary Instrumentation and Control wire required for a fully functioning Instrumentation and Controls System as shown on the Drawings.

B. Work Specified in Other Divisions and Sub-Divisions:

1. Process piping, installation of inline instrumentation, air compressors, main air supply headers, and other mechanical work and equipment.

2. General mechanical requirements as specified in Division 22.

3. Equipment and controls that are provided as part of a package system.

4. Refer to Division 26 Specifications for specific requirements for wire, conduit, grounding, and other electrical equipment.

5. Final control elements as specified in Division 40.

1.02 REFERENCE DOCUMENTATION AND STANDARDS

A. American National Standard Institute (ANSI) Publications:

1. Y14.15a Drafting Practice.

B. Instrumentation Society of America (ISA) Publications:

1. S5.4 Instrument Loop Diagrams.

2. S20 Specification Forms for Process Measurement and Control Equipment, Primary Elements and Control Valves.

C. Manufacturer's data sheets, materials selection, and installation guidelines for the instrumentation specified in these specifications and Drawings.

1.03 QUALIFICATIONS

A. The Contractor shall be an entity that has completed similar WWTP projects and who has demonstrated experience in purchasing, calibrating, fabricating, installing, and testing the equipment listed in this Specification section.

B. The Contractor shall have at least 5 years of experience in performing all aspects of the type of work specified in this section and shown on the Drawings.

1.04 CONTRACTOR AND SUBCONTRACTOR SYSTEM RESPONSIBILITIES

A. General: The equipment as specified in this Division shall be considered an integrated system. Entire system installation including calibration, verification, startup, operation testing, and training shall be performed by qualified personnel, possessing all the necessary skills and equipment, and who have had experience performing similar installations. Entity responsibilities include:

1. Contractor: To obtain technical data, determine performance requirements, develop detail installation designs, and coordinate the selection of specified equipment to meet the design conditions stated.

2. Instrumentation and Control (I&C) Subcontractor: Refer to Section 40 70 00, paragraph 1.04.

3. Hardware System Integrator (HSI): Refer to Section 40 68 13.

4. Software System Integrator (SSI): Refer to Section 40 68 13.

B. System Responsibilities:

1. Technical: Obtain technical data, determine performance requirements, develop installation details and integrate supplied equipment where depicted on the Drawings.

2. Compatibility: See that components of the process system, including equipment specified under other Divisions, are compatible and function properly as a system. Provide such additional equipment, accessories, etc., as are necessary to meet these objectives at no cost to the Owner.

3. Coordination: For control components, devices, and systems specified in other divisions, or shown on the Drawings.

   a. Provide technical advice to mechanical and electrical subcontractors as necessary regarding their installation of equipment.

   b. Verify the correctness of installation of all equipment.

c. Verify that the proper type, size, and number of control wires with their conduits are provided.

d. Verify that the proper type, size, and number of pneumatic tubes with their conduits are provided.

e. Verify that proper electric power circuits provided for all components and systems.

f. Resolve all manufacturers' installation discrepancies between requirements and the detail requirements of the Drawings and Specifications.

g. Supervise final signal connections, both electric and pneumatic, to all process instrumentation and control equipment.

h. Adjust, startup, and test all process instrumentation and control equipment.

i. Provide specified documentation and training.

4. Performance: While the Drawings provide sufficient information to establish the form and function of the systems and their relationships, the responsibility for system integration and performance rests solely with the Contractor. The Engineer provides technical instruction and guidance where needed.

5. Site and Instrument Inspection: Inspect site for conformance to Drawings, paying special attention to space allocation and dimensions shown or required on Drawings. Inspect completed work and verify that it is ready for installation of equipment. Inspect each piece of equipment for damage, defects, completeness, and correct operation before installing.

1.05 SUBMITTALS

A. The information described in this section shall be submitted to the Engineer in accordance with Section 01 33 00, "Contractor Submittals".

1. Shop Drawings: Submit Shop Drawings (diagrams) for review in complete bound sets indexed by Specification number, with exterior tabs marked by subject. Submit manufacturer's catalog cuts for each item for which Shop Drawings are not required. Manufacturer's catalog cuts, specifications, or data sheets shall be clearly marked to delineate the options or styles to be furnished. Show dimensions, physical configurations, methods of connecting equipment together, mounting details, and wiring schematics. Drawings shall be complete with device tag numbers, wire numbers, and terminal board numbers. Submit fabrication details, nameplate legends, and control panel internal wiring and piping schematic Drawings. Submit panel graphic Drawings where applicable. Include material lists and/or bills of material

B. Record Drawings: Submit a revised set of Shop Drawings that incorporates all change orders and modifications made during performance of the work. In addition, submit equipment and device installation diagrams and other Drawings as necessary to depict the "as-constructed" condition of equipment. Include all installed field and panel conduit and piping/tubing runs and routing, tray systems, supports, mounting details,

interconnection diagrams with cable, wire, tube, and termination numbers. Submit a copy of CAD produced Drawings on magnetic media in AutoCAD DWG format.

C. Operation and Maintenance Manuals: Furnish Operation and Maintenance Manuals, including Instruction Manuals and Part Lists, for equipment provided under Division 40 as required by Division 01. Obtain data from manufacturers, and format and bind as specified. Obtain distribution method instructions from the Owner or his representative.

1. Schedule: Deliver at least two (2) copies of manuals in 3-ring binders (8-1/2 by 11-inch format) not later than the equipment shipment date.

2. Contents: Include in manuals not less than the following information, as applicable, for each process equipment, subsystem and/or packaged systems:

   a. General, introduction and overall description, purpose, functions, simplified theory of operations, etc.

   b. Specifications (including equipment specification data sheet as described above under Shop Drawings), sufficiently detailed for reordering exact duplicates of the original items.

   c. Installation instructions, procedures, sequences, tolerances, and precautions.

   d. Operational procedures.

   e. Shutdown procedures.

   f. Maintenance, calibration, and repair instructions.

   g. Parts list and spare parts recommendations.

   h. Calibration curves, rating tables, and any other data showing the relationship of the variable inputs and the calibrated output of all measuring devices and controlled equipment.

3. Format:

   a. Use Drawings and pictorials to illustrate the text to the extent necessary to insure a clear, concise presentation. If manuals have been written to cover a family of similar equipment or equipment, strike out inapplicable information in a neat fashion or emphasize applicable portion by heavily weighted arrows, circles, or boxes; whichever provides the clearest and neatest presentation.

   b. Group manuals by system control panels, including field instrumentation connected or associated with the panel. Where identical equipment are used in more than one control loop or subsystem, include only one instruction manual, per panel grouping; however, an index by tag number for all equipment shall identify its location in that manual.

   c. Provide control loop and/or subsystem operational descriptions to identify the function of each instrument and its relation to the other equipment in the loop.

4. Binding: Bind each manual in a cover which indicates the panel or process area to which it applies, manufacturer's name, local address and telephone number, and year of purchase. Punch and bind manuals in standard three-ring binders and include system name and subcontractor's name on binding.

D. Accessory and Maintenance Materials: Submit data for the following items:

1. Special Tools and Accessories: Special tools, equipment, and accessories for maintaining equipment and equipment requiring periodic repair and adjustment as specified elsewhere herein. Also, furnish special lifting and handling devices for equipment requiring such devices.

2. Maintenance Materials and Spare Parts: Submit a list of manufacturer recommended spare parts for each item specified. Refer to other sections of these Specifications.

a. Submit signed Certificate 01 33 00 "List of Schedule for Spare Parts or Materials".

E. Demonstration and Final Operation Test Plan and Results: Submit a document that outlines all procedures to be used in final operational testing of instrument and control systems. Include a description of each system, the scope of testing, test methods and materials, testing equipment and recorders, a list of functional parameters to be recorded on each item, and Shop Drawings showing temporary bypasses, jumpers, and devices.

1.06 QUALITY ASSURANCE

A. Standard of Quality: The Contractor shall provide equipment of the types and sizes specified which has been demonstrated to operate successfully. Provide equipment which is new and of recent proven design.

1.07 INSPECTIONS

A. The Engineer may inspect the fabricated equipment at the factory before shipment to job site. Provide the Engineer with two week prior written notice (preferably e-mail) so that an inspection can be arranged at the factory.

B. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests, and operations.

C. Favorable review of the equipment at the factory only allows the manufacturer to ship the equipment to the project site. The Contractor shall be responsible for the proper installation and satisfactory startup operation of the equipment to the satisfaction of the manufacturer and the Engineer.

1.08 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Box, crate, or otherwise enclose and protect equipment and equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element that could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Notify the Engineer in writing in the event that any equipment or material is damaged. Obtain

prior favorable review of the Contractor/manufacturer proposed Replacement/Repair by the Engineer before making repairs to or replacing damaged products.

B. The appended Schedule lists pertinent information about equipment identified for the Contract. The Schedule is a comprehensive listing of devices but shall not be construed as a Bill of Materials or as a complete listing. For example, equipment procured as a packaged unit or assembled in the field to perform a standardized function (such as water seals) may contain equipment that are not listed. Upon request, a copy of the database can be provided.

PART 2 – PRODUCTS

2.01 MATERIALS AND STANDARD SPECIFICATIONS

A. Provide equipment, equipment, and materials suitable for service conditions and meeting standard specifications such as ANSI, ASTM International (ASTM), etc. The intent of this Specification is to secure equipment and equipment of a uniform quality and manufacture throughout the plant. All equipment in the plant of the same type shall be made by the same manufacturer.

B. For any approved substitutions per Section 01 01 00, it is the responsibility of the Contractor to adhere to the requirements of the substituted equipment's manufacturer's installation requirements and these specifications. If the manufacturer's installation requirements conflict with these specifications/Drawings in such a way that the as designed specifications/Drawings may void the substituted equipment manufacturer's warranty or diminish the functionality of the equipment and or process, the manufacturer's requirements shall prevail.

2.02 NAMEPLATES

A. For each piece of equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings, and the model designation.

B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the Engineer, with epoxy cement. Where no inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the Engineer upon prior request by the Contractor.

C. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Engineer.

D. Provide CAUTION or SAFETY nameplates to alert operators of special conditions that may result in faulty equipment operations. Devices containing batteries that must be replaced periodically must be clearly identified. Nameplates are not required if the device senses and displays a low battery warning.

2.03 NAME TAGS

A. All instrumentation and equipment items or systems shall be identified by name tags. Field equipment shall be tagged with the assigned instrumentation tag number listed in the Equipment Schedule(s).

B. Name tags shall be stainless steel with engraved or stamped black characters of 3/16 inch minimum height. Tags shall be attached to equipment with a tag holder and stainless steel band with a worm screw clamping device. Use 20-gauge stainless steel wire where banding is impractical. For field panels or large equipment cases use stainless steel screws; however, such permanent attachment shall not be on an ordinarily replaceable part.

2.04 FIELD-MOUNTED EQUIPMENT

A. All instrument and control equipment mounted outside of protective structures shall be equipped with suitable surge arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Protective devices used on 120 Vac inputs to field mounted equipment shall be secondary valve surge protectors conforming to the requirements of ANSI C62.1.

2.05 EQUIPMENT LOCATIONS

A. Provide equipment and materials suitable for the types of locations in which they are located as defined under Division 40. All equipment specified for field mounting shall be weatherproof and splash proof as a minimum. If electrical or electronic components are contained within the equipment, they shall be housed in NEMA 3R gasketed cases, and NEMA 4X in corrosive locations unless noted otherwise on the Drawings or specific item specification.

2.06 PAINTING

A. Factory paint all equipment and equipment except where installed in pipelines. Where instrument panels are installed adjacent to electrical control panels provided under Division 26, provide instrument panels of identical color to that of electrical control panels. Paint as required in Division 09 for structural supports, brackets, etc. Repair damaged factory paint to satisfaction of the Engineer. Feathering, priming, and painting shall produce a reasonable match to the surrounding paint work.

2.07 FASTENERS

A. Fasteners for securing equipment to walls, floors, and the like shall be either hot-dip galvanized after fabrication or stainless steel. Provide stainless steel fasteners in corrosive locations. When fastening to existing walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8 inch.

2.08 TUBING, PIPE, FITTINGS AND SUPPORTS

A. General: Instrument tubing listed below is required for all equipment and control valves. Select the appropriate tubing materials to satisfy service conditions except where specifically shown on Installation Detail Drawing.

1. Copper Tubing: Soft-annealed copper tubing shall be 1/4 inch O.D. by 0.030-inch wall, 3/8-inch O.D. by 0.032-inch wall, or 1/2-inch O.D. by 0.032-inch wall as shown on the Drawings. Copper tubing shall be seamless copper, Type DHP, bright annealed after coiling, dehydrated and sealed in 50-foot aluminum coils, per ASTM B75. Use for instrument or valve connections only.

2. Copper Tubing: Hard drawn copper tubing shall be in accordance with ASTM B88. Sizes shall be 3/8-inch standard: 3/8-inch O.D. by 0.030-inch wall; 1/2-inch standard: 1/2-inch O.D. by 0.035-inch wall; or 5/8-inch standard: 5/8-inch O.D. by 0.040-inch wall in 20-foot straight lengths with plastic capped ends. Use for header or branch service only.

3. Stainless Steel: Stainless tubing shall be Type 304 seamless, cold drawn and annealed per ASTM A269. Sizes shall be 1/4-inch O.D. by 0.045-inch wall, 3/8-inch O.D. by 0.035-inch wall or 1/2-inch O.D. by 0.035-inch wall. Use for instrument or valve connections.

4. Pneumatic Tubing: Pneumatic tubing for panel internals shall be 1/4 or 3/8-inch O.D. rigidwall, clear polyethylene, 125 psi rating. Tubing shall be supported in plastic duct or conduit where appropriate. Use for enclosed or indoor instrument or valve connections.

5. Fittings:

    a. Copper Tube: Solder joint fittings shall be seamless wrought copper per ASTM B75. Compression fittings shall be Brass equal to Imperial or Swagelok.

    b. Stainless Steel Tube: Weld joint fittings shall be Type 304 stainless. Compression fittings shall be Type 316 stainless steel equal to Imperial or Swagelok.

    c. Supports for Tubing: Supports located in areas exposed to the weather or corrosive atmosphere shall be Type 304 stainless steel Unistrut or equal or made of steel conforming to ASTM A276. Supports not exposed to the weather or corrosive atmosphere shall be carbon steel painted.

    d. Weld joint fittings shall be permitted for header and branch service only. Instrument and valve connections shall be compression-type only. Use unions on as necessary to simplify instrument removal.

6. Valves:

    a. Pipe, Pipe Fittings, and Valves: Main-line piping material and root valves for instrumentation shall be as specified in Section 22 13 16.

    b. Instrument valves shall be 1/4 inch, 3/8 inch, or 1/2 inch from Whitey or Hoke to match tubing material and size.

2.09 INSTRUMENT CALIBRATION

A. Each field instrument shall be calibrated at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span using test equipment to simulate inputs and read outputs that are rated to an accuracy of at least five times greater than the specified accuracy of the instrument being calibrated. Such test equipment have accuracies traceable to the National Institute of Standards and Technology (NIST).

B. Submit a written report to the Engineer on each instrument. This report shall include a laboratory calibration sheet or the manufacturer's standards calibration sheet on each instrument and calibration reading as finally adjusted within tolerances.

C. The Contractor may, at his option, choose to perform calibration on an instrument by acquiring the services of an independent test lab, or by obtaining the required test equipment and performing the calibration.

2.10 FACTORY TESTING

A. All fabricated equipment shall be tested before it leaves the factory. At the factory verify wiring continuity and equipment operation by simulating input and output.

B. Factory testing of control panels/devices/equipment shall be completed, documented and provided to the Owner/Engineer for favorable review prior to shipping. Refer to individual Specification sections for tests requiring favorable review.

C. Upon completion of factory testing, submit a report certifying the control panels/devices/equipment are operable and meet the Specifications.

PART 3 – EXECUTION

3.01 MOUNTINGS

A. Mount and install equipment as indicated. Mount field equipment on pipe mounts or other similar means in accordance with suppliers' recommendation. Where mounted in control panels, mount according to requirements of that section.

B. Equipment specified for field mounting shall be suitable for direct pipe mounting or surface mounting.

C. Note that applicable specifications require detail Drawings showing seismic sway bracing design and anchorage requirements for their equipment. Seismic, anchorage and bracing are specified in Section 13 05 41.

D. All devices shall be accessible to operators for servicing, operating, reading, etc. Provide permanent platforms to assure devices are accessible.

3.02 ELECTROMAGNETIC INTERFERENCE (EMI)

A. Construction shall proceed in a manner which minimizes the introduction of noise (RFI/EMI) into the Process Control System and associated components/devices.

3.03 PREPARATION

A. Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing equipment and equipment. Maintain the areas in a broom-clean condition during installation operations.

B. Equipment shall be protected during shipping, storage, and construction to prevent damage and prevent dust accumulation. Other protective measures (lamp, strip heaters, shaft rotation, etc.) shall be included as required by the manufacturer.

3.04 PERFORMANCE TESTING AND OPERATIONAL TESTING

A. General: The purpose of the field testing is to verify equipment are calibrated and operationally performing their intended function. Provide the services of factory trained and experienced Engineers to perform verification and operational testing as prescribed below. Since the initial calibration of equipment may not satisfy the final operation of system, perform recalibration or adjust setpoints as required to satisfy the performance requirements of the system. Notify the Engineer and Owner in writing a minimum of 48 hours prior to the proposed date for commencing final operational testing and acceptance.

B. During Process System verification:

1. Make initial or provisional settings on levels, alarms, etc. listed in the Instrument Schedule.

2. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point.

3. Cause malfunctions to sound alarms or switch to standby to check system operation.

4. Check all loop equipment thoroughly for correct operation.

5. Immediately correct all defects and malfunctions disclosed by tests.

6. Submit a report certifying completion of verification of each process system. This report shall include a data sheet on each piece of equipment tested that indicates equipment tolerances, calibration verification, data, and initial settings made to equipment and devices.

C. Operational Testing and Tuning: Upon completion of equipment verification, test all systems under process conditions in the presence of the Owner or designated representative. System testing shall be accomplished in accordance with the Engineer approved Test Plan. The test for each portion thereof shall be witnessed, documented, and signed off upon completion by the Engineer. The intent of this test is to demonstrate and certify the operational interrelationship of process equipment, instrumentation, and control systems. This testing shall include, but not be limited to:

1. Making final adjustments to levels, alarms, etc.

2. Optimum tuning of controllers.

3. Checking all alarms, failure interlocks, and operational interlocks.

4. Verifying all computer input and outputs and CRT displays are fully functional.

5. Verifying automatic computer-generated reports are performing satisfactorily.

6. Immediately correcting all defects and malfunctions and retesting.

7. Submit the witnessed test results and a transmittal letter indicating that all required systems have been tested satisfactorily and the systems meet all the functional requirements of their applicable specifications.

8. Sampling of process streams to ensure automated processes meet the requirements.

3.05 INSTRUCTION OF OWNER'S PERSONNEL

A. Provide the services of a factory trained and field experienced instrumentation Engineer to conduct group training of the Owner's designated personnel in the operation of each piece of equipment. This training shall be for the time period of up to five working days and shall be performed during the operational testing period. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the Operation and Maintenance Manuals furnished under these Specifications.

END OF SECTION

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SECTION 40 61 93

PROCESS CONTROL SYSTEM INPUT/OUTPUT LIST

PART 1 – GENERAL

1.01 SUMMARY

A. Provide input/output (I/O) connections to programmable logic controllers (PLC) as shown on the Drawings, as specified in the lists in Appendix D, and as needed for a complete and proper installation.

B. Provide I/O connections for the following panels:

1. LCP-1000 (existing).

2. LCP-2000 (new, as of this Contract).

3. LCP-2014 (new).

4. LCP-2023 (existing, formerly LCP-2000 as of this Contract).

5. LCP-3600 (existing).

C. Related Work: Documents affecting work under this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Division 01 – General Requirements of these Specifications.

1.02 SUBMITTALS

A. Hardware Integrator shall submit final I/O list identifying all electrical connections have been made.

1.03 QUALITY ASSURANCE

A. It is the Hardware Integrator's responsibility to verify the existing wire numbers, terminal numbers and configuration of equipment. Note information in submittals, final as-built, and O&M documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Four original Equipment and I/O spreadsheets are available upon request.

B. The fonts shown on the Equipment and I/O lists included in Appendix D denote:

1. Italics for existing connections to the SLC-500 PLCs items.

2. Non-italics for new connections items.

3. Gray font for future connections not part of this Contract.

3.02 LCP-1000 I/O LIST

A. See Appendix D-1.

3.03 LCP-2000 I/O LIST

A. See Appendix D-2.

3.04 LCP-2014 I/O LIST

A. See Appendix D-3.

3.05 LCP-2023 I/O LIST

A. See Appendix D-4.

3.06 LCP-3600 I/O LIST

A. See Appendix D-5.

END OF SECTION

SECTION 40 62 63

OPERATOR INTERFACE TERMINALS (OIT)

PART 1 – GENERAL

1.01 SUMMARY

A. Provide Operator Interface Terminals (OIT), also referred to as a Human Machine Interface (HMI), as shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Work: Documents affecting work under this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Division 01 – General Requirements of these Specifications.

1.02 SUBMITTALS

A. Submit Shop Drawings in compliance with pertinent provisions of Section 01 33 01, including the manufacturer's detailed specifications.

B. Submit operation and maintenance (O&M) manuals in compliance with pertinent provisions of Section 01 78 23.

1.03 QUALITY ASSURANCE

A. All equipment to be provided by one manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 40 61 13.

PART 2 – PRODUCTS

2.01 GENERAL

A. Design panel-mounted HMI to replace traditional hard wired panel devices such as pushbuttons, switches, pilot lights, digital displays, etc., with graphic video display.

2.02 PANEL-MOUNTED HMI

A. Provide panel-mounted HMI with the following requirements:

1. Display Type: Color Active Matrix Thin Film Transistor (TFT) with field replaceable backlight.

2. Display Size: 15-inch diagonal.

3. Operator Input: Resistive touch-screen.

4. Communication Port: Ethernet or other industrial protocol as shown on the Drawings.
5. Memory: As required for application.
6. Real Time Clock: Backed up for 30 days, minimum.
7. Power: 24 Vdc.
8. Operating Temperature: 0 to 50 degrees C.
9. Rating: NEMA4x, IP65.
10. Certifications: UL Listed.
11. Cables to connect to communication network.
12. Acceptable Manufacturers:
    a. C-More, EA9-T15CL.
    b. No substitutions.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install HMI in accordance with manufacturer's recommendations.

B. Configure the HMI in accordance with manufacturer's instructions, and as shown on the Drawings.

END OF SECTION

SECTION 40 63 43
PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide programmable logic controllers (PLC) as shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Provide PLCs for the following panels:

1. LCP-1000 (existing).

2. LCP-2000 (new, as of this Contract).

3. LCP-2014 (new).

4. LCP-2023 (existing, formerly LCP-2000 as of this Contract).

5. LCP-3600 (existing).

C. Related Work: Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Division 01 – General Requirements of these Specifications.

1.02 SUBMITTALS

A. The following information described herein and in Section 40 61 13, paragraph 1.05, shall be submitted to the Engineer in accordance with Section 01 33 00, “Contractor Submittals”. Submittals shall include the following:

1. Product Data: Provide product information for the PLC, I/O modules, communication modules, controllers, chassis, power supply, cable, and controller firmware.

2. Product Coordination: Submit a completed PLC system report for the CompactLogix hardware configuration including I/O testing and commissioning Plan to Owner and Engineering 20 days prior to testing and commissioning.

a. Submit a completed PLC system report including I/O report signed by the Designated Software Programmer within 10 days of completing the testing and commissioning.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Maintain area free of dirt and dust during and after installation of products.

1.04 QUALITY ASSURANCE

A. Provide all equipment by one manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 26 05 10, “Common Work Results for Electrical”.

1.06 SPARE MATERIALS

A. Provide the following number of spare parts to the Owner that match items specified:

1. One spare processor unit for each unique processor installed.

2. One spare I/O module for each unique I/O module type installed.

3. One spare communication module for each unique communication module installed.

4. One spare power supply for each unique power supply installed.

B. Package all spare parts and label all packages with quantity, item description, and part number.

PART 2 – PRODUCTS

2.01 GENERAL

A. The section specifies the requirements for DIN rail mounted type of PLCs.

B. Design programmable logic controller (PLC) to accept input contact and analog signals, perform the functions specified, and output contact and analog signals to control and/or indicate the specified processes.

C. Provide DIN rail -mounted style PLC consisting of I/O racks, power supplies, CPUs, memory units, network communication modules, and I/O modules:

1. Provide a modular type system with the necessary number and type of inputs and outputs:

a. Noise immunity to meet NEMA Standard ICS2-230.

b. Rack-mounted module removable without disconnecting the wiring harness from its terminals.

2. Provide expansion cables and power supplies at each location as required.

3. DIN rail mounted PLC shall fit within the space provided in the existing panels and as shown on the new panel drawings.

D. Provide DIN rail mounted style PLC consisting of CPUs, power supplies, memory units, network communication modules and I/O modules:

1. Provide a modular type system with the necessary number and type of inputs and outputs.

2. Provide expansion modules and power supplies at each location as required.

3. Provide expansion module interconnect cables as required.

2.02 DIN RAIL MOUNTED PLC

A. Common Hardware Ratings:

1. Operating Temperature Range: 0 to +55 degrees C.
2. Storage Temperature Range: -40 to +85 degrees C.
3. Humidity Range: 5 to 95 percent noncondensing.
4. Noise Immunity in compliance to NEMA Standard ICS 2-230.
5. Operation Vibration Rating: 5.0 G at 10 to 500 Hz, 0.030-inch peak-to-peak.
6. Isolation Level: 1500 V between backplane and I/O.
7. Dielectric Withstand Rating: 1500 Vac in compliance with UL 508, CSA C22.2 No. 142.

B. Processor Unit:

1. Program Memory: 2 MB RAM, minimum.
2. Capable of controlling up to 30 I/O modules.
3. Online programming including runtime editing.
4. Standard RAM memory back-up provided through minimum 2-year lithium battery.
5. Memory card: Industrial SD card, 1 GB minimum.
6. LED indicators for: RUN, FORCE, I/O, OK, NS, LINK 1, LINK 2, SD
7. Three Communication Ports:
    a. Two Ethernet port that supports Ethernet/IP protocol.
    b. One USB.
8. Real-time clock.
9. Acceptable Manufacturer:
    a. Allen-Bradley, CompactLogix 1769-L33ER.
    b. No substitutions.

C. Discrete Input Modules:

1. Operating Voltage: 79 to 132 Vac.
2. Sixteen non-isolated inputs or eight isolated inputs as required.

3. LEDs to indicate the status of each I/O point.
4. Acceptable manufacturer for 16 non-isolated inputs:
    a. Allen-Bradley, CompactLogix 1769-IA16.
    b. No substitutions.
5. Acceptable manufacturer for eight isolated inputs:
    a. Allen-Bradley, CompactLogix 1769-IA8I.
    b. No substitutions.

D. Analog Input Modules:
1. Four input channels per module.
2. Ratings:
    a. Current Rating: 0 to 20 mAdc, 4 to 20 mAdc.
    b. Voltage Rating: Plus/Minus 10 Vdc, 0 to 10 Vdc, 0 to 5 Vdc, 1 to 5 Vdc.
3. Terminal Impedance:
    a. Current Rating: 250 ohms.
    b. Voltage Rating: 220 K ohms.
4. LEDs to indicate the status of each I/O point.
5. Acceptable Manufacturer:
    a. Allen-Bradley, CompactLogix 1769-IF16C.
    b. No substitutions.

E. Relay Output Modules (Isolated):
1. Voltage Rating: 5 to 265 Vac.
2. Eight individually isolated relay outputs.
3. Continuous Current Rating per Point: 2.5 A ac not to exceed 1440 VA for the module.
4. Continuous Current Rating per Module: 16 A ac, 2.5 A/common.
5. LEDs to indicate the status of each I/O point.

6. Optical isolation between digital and field circuits.

7. Acceptable Manufacturer:

    a. Allen-Bradley, CompactLogix 1769-OW8I.

    b. No substitutions.

F. Analog Output Modules:

1. Two output channels per module, single-ended.

2. Ratings:

    a. Current Rating: 0 to 20 mA, 4 to 20 mA.

    b. Voltage rating of plus/minus 10 Vdc, 0 to 10 Vdc, 0 to 5 Vdc, 1 to 5 Vdc.

3. LEDs to indicate the status of each I/O point.

4. Acceptable Manufacturer:

    a. Allen-Bradley, CompactLogix 1769-OF8C.

    b. No substitutions.

G. Power Supply:

1. Line Voltage Rating: 85 to 265 Vac.

2. User Power Capacity: 250 mA at 24 Vdc.

3. Short circuit protection via front access fuse with cover.

4. Plus 5 V and Plus 24 V overvoltage protection.

5. LED to indicate that input power is available.

H. Acceptable Manufacturer:

1. Allen-Bradley, CompactLogix 1769-PB4.

2. No substitutions.

I. Provide taps and cables as required for connecting PLC to related devices.

J. CompactLogix devices shall be 1769 Modular CompactLogix Controller compatible.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install PLC in accordance with manufacturer's recommendations and as required to provide complete and fully functional systems.

B. Install equipment in configuration shown in Drawings.

C. Install I/O connections in configuration shown in Drawings and in the I/O list per Section 40 61 93.

D. Install component identification and wire tags on all wiring.

E. Hardware integrator shall work with the PLC software programmer to ensure PLC system including the I/O is properly working.

3.02 TESTING AND COMMISSIONING

A. Testing shall include visual verification of enclosure, disconnect device, fused isolation transformers, master control relay, terminal blocks, wiring ducts, suppression devices, etc.

B. Verify PLC and enclosure are bonded to building grounding system.

C. Verify that all connections between PLC and devices are complete.

D. Verify that all incoming power supply matches the voltage setting for the PLC.

E. Verify that all protective devices are set to their appropriate trip settings.

F. Verify that the emergency stop button operates properly and the equipment shuts down when the emergency stop button is pushed.

G. Verify that all input/output devise are connected to the correct input/output points and giving the correct signals.

H. Input devices can be manipulated to give the open and closed contact conditions and LED on the input module is observed. I/O shall also be confirmed at the HMI.

I. Verify that loading (transferring) and testing the software operates correctly.

J. Run the software through the checking program and provide list of a screen or as a printout with any errors detected.

K. Verify UPS provides power to PLC system equipment during a utility power outage and before the standby diesel generator provides power.

L. Submit a PLC system test report including I/O commissioning test report. Test report shall be signed as completed by both the hardware integrator and software programmer.

3.03 HOUSEKEEPING

A. Use cable management to secure cables in PLC control cabinet.

B. Clean units as recommended by manufacturer.

C. Redline the construction Drawings to show changes made during the construction. Submit redline Drawings to the Tulalip Tribes for preparation of Record Drawings.

END OF SECTION

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SECTION 40 67 00

CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide process control panels and hardware as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

B. Work under this section includes:

1. Construction and supply of pre-wired process control panels.

2. Modification of existing control panels to replace the older PLC with new.

3. Start-up and testing of the process control panels. This includes:

   a. Panel power startup, verification, and testing.

   b. Factory I/O testing from the terminal strip into the configured PLC I/O data table.

   c. Field I/O testing from the field device into the configured PLC data table.

   d. NOTE: The PLC I/O tests will require the Contractor to configure the PLC I/O cards based on the scaled values as identified in the instrumentation and equipment specifications. The configured PLC database files will be provided to the Owner/Engineer for review in the native ControlLogix 5000 software format on a USB memory device.

4. Providing on-site training to the operations staff.

1.02 REFERENCE STANDARDS

Reference	Title
National Electrical Manufacturers Association (NEMA):	
ICS 1	General Standards for Industrial Controls and Systems.
ICS 2	Standards for Industrial Control Devices, Controllers and Assemblies.
ICS 4	Terminal Blocks for Industrial Control Equipment and Systems.
ICS 6	Enclosures for Industrial Controls and Systems.
Underwriters Laboratories, Inc. (UL):	
UL 508A	Industrial Control Equipment.

1.03 SUBMITTALS

A. The information described in this section and in Section 40 61 13, paragraph 1.05, shall be submitted to the Engineer in accordance with Section 01 33 00, “Contractor Submittals”.

B. Submit Shop Drawings in compliance with pertinent provisions of Division 01, including the control panels, components, sequence of operation description, and manufacturer’s detailed specifications (cut-sheets or data sheets for all proposed devices):

   1. Each control panel supplier to submit documentation for all supplied control panels and components in one submittal package.

   2. UL Certifications of the fabricator/panel shop to be used for construction of the industrial control panels.

C. Submit control system Drawings, including Drawing index, bill of materials, control system configuration overview, panel dimensions and layouts, control wiring schematics, instrument loop diagrams, and panel/field interconnecting diagram:

   1. Submit the initial Drawings on 11-inch by 17-inch sheets with the Shop Drawings.

   2. After the control and monitoring system is fully operational and modifications have been made, submit the final As-Built Drawings per Division 01 and as follows:

      a. Printed copies on 11-inch by 17-inch sheets.

      b. Electronic copies compatible with AutoCAD on either CD-ROM or USB flash drive.

D. Submit a factory or shop operational test report for each panel verifying hardware and functional requirements not less than 10 days prior to shipment of the panels. The Engineer shall witness the testing and be given not less than 10 days' notice prior to testing.

E. Submit the Control System test and commissioning Plan a minimum of 20 days prior to beginning testing and commissioning.

F. Submit the Control System testing and commissioning test report within 10 days of test/commissioning date.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Conform to sections of Division 01 during and after installation of the control and monitoring systems.

B. Maintain area, including enclosures, free of dirt and dust during and after installation of products.

1.05 UL LABEL AND ETL FIELD CERTIFICATION

A. UL and ETL Labels:

1. Each assembled control panel and terminal cabinet shall bear the panel UL label. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault interrupters, isolation transformers, fuses, and any other necessary equipment, even though such equipment is not indicated on the Drawings.

2. In addition to UL labelling, the Contractor shall utilize the services of UL or ETL to Field Certify the modified panels.

3. The Washington State Labor and Industry's "Engineer Approval" method as described in WAC 296-46B-997 shall not be an acceptable approval method in lieu of the UL or ETL Panel Certification.

1.06 QUALITY ASSURANCE

A. Assemble and wire all panels in factory or shop:

1. Provide color-coded wiring in accordance with applicable codes and laws to facilitate maintenance and repair of control panel. Post color-coding schedule inside the control panel.

2. Provide minimum 16 AWG control wires and provide spiral wrap, tie wrap, fasteners, and wire duct as required.

3. Label all wiring at each end with numbers corresponding to the wiring schematics. Show numbering on the As-Built Drawings. Use tubular heat shrink-type or self-laminating vinyl wire markers printed using thermal printer.

4. Label all terminal blocks with numbers corresponding to the wire numbers.

5. Segregate wiring of different voltage levels. All intrinsically safe circuits shall be segregated within the applicable control panels and conduit.

6. Provide nameplates for enclosure, instruments, devices, and components. Descriptions on the nameplate to agree with the descriptions on the As-Built Drawings.

B. Provide enclosures, devices, components, etc., which have been listed and labeled by Underwriter's Laboratories.

C. Perform a factory or shop operational test on each panel. A minimum of 10 days' notice shall be provided to Owner and Engineer.

PART 2 – PRODUCTS

2.01 CONSTRUCTION

A. General:

1. Provide panels as shown on the Drawings. Control Panels shall conform to the requirements of UL 508A – Industrial Control Panels.

2. Panels located in and around any chemically corrosive component shall be IP-65/NEMA 4X Stainless Steel. Panels located in the control room shall be NEMA 1 or 12. All other panels shall be IP-65/NEMA 4.

3. Any penetrations in an IP-65 NEMA 4/4X cabinet shall conform to IP-65 requirements to keep the integrity of the IP-65 panel rating (i.e., Panel mounted PC/HMI, Control Stations, process indicators, etc.).

4. The panel itself shall conform to NEMA Standards ICS 1 (General Standards for Industrial Controls and Systems) and ICS 2 (Standards for Industrial Control Devices, Controllers and Assemblies). Control panels measuring 5 feet in height or less shall be supported via Unistrut and wall mounted in areas shown on the Drawings. Dual door control panels shall be designed for floor mounting. All panels shall be wall-mounted or freestanding floor mounted, as shown. Provide sufficient access to the panels.

5. The enclosures shall be rated to withstand seismic forces as specified by the building code for western Washington State. Enclosures shall conform to requirements of NEMA Standard ICS 6 (Enclosures for Industrial Controls and Systems). Panels shall be Hoffman as identified on the Drawing Bill of Material or Engineer approved equal.

6. The enclosures shall have vertically hinged front doors; provide hinge on side of panel that ensures compliance with the 30-inch rule in NEC Paragraph 110 16(a). Freestanding enclosures shall have doors secured by keyed three-point latches. Mount the devices through the doors or on recessed plates. Provide nameplates indicated on the Drawings. Each component within the panel shall be securely mounted and arranged for easy servicing, such that all adjustments and component removal can be accomplished without disturbing other components. No fastening devices shall project through the outer surfaces of the cabinet and all components and terminals shall be mounted on mounting pans within the panels.

B. Safety Requirements: The electrical supply to each control panel shall be arranged to be disconnected by a single switch or circuit breaker, except for necessary foreign circuits as required by NEC and the AHJ.

C. Wiring: Factory wire the control panels. Cable all panel wiring by securing to the panel surfaces with plastic cable ties. Permanently identify each wire at each termination by means of a heat shrink numbered sleeve. Number all wires as shown in the detailed Drawings. Provide black wire color for ac wiring with white neutral and green ground from panel boards Type MTW or THHN, 600 volt, stranded copper wire except where prefabricated wire harnesses are used (typically between the PLC I/O card and the

I/O terminal wiring in the panel). Refer to Section 26 05 19 for wire color with respect to the voltage and purpose of the wire:

1. Where wiring crosses hinged surfaces, provide an 18-inch “U” shaped hinge loop of extra flexible wires secured at both ends. Provide ring-type lugs for all panel wiring; spade-type lugs are unacceptable. Use ratchet type crimping tools that do not release until proper crimp pressure has been applied.

D. Terminal Blocks: Terminal blocks shall be rated 600 volts and shall conform to requirements of NEMA Standard ICS 4 (Terminal Blocks for Industrial Control Equipment and Systems). The terminal block and terminal lug shall be compatible. Provide disconnecting terminals for any circuit within the control panel that can be energized when the branch circuit feeding the control panel, if any, is off. All installed PLC I/O modules shall be wired to panel field terminal blocks. All field wiring shall terminate on field side of the panel field terminal blocks; wiring directly to PLC I/O modules is not permitted. Provide terminals for all external (field) connections and provide, at a minimum, 25 percent spare terminals. Identify each terminal permanently with the numbering scheme shown on the Drawings. Terminals shall be Phoenix Contact UK Series, AB 1794, or approved equal. Note: Alternate IEC wiring systems from Phoenix Contact for high density wiring terminations shall be called out as a substitution and shall require approval prior to procurement.

E. Nameplates: Provide nameplates as shown on the Drawings, and as specified in Section 40 70 00. A “CAUTION” nameplate shall be attached to the outside of access doors warning of foreign voltages inside the panel (see “Safety Requirements”).

F. Finish:

1. After fabrication, all external welds shall be ground smooth. The entire unit shall be thoroughly degreased, then filed, and sanded. All carbon steel surfaces shall be given a rust-inhibiting treatment or passivator, then one coat of synthetic primer, followed by two coats of synthetic enamel. The average overall finish shall be at least 3 mils in thickness. All damage to the finish during installation shall be touched up at the jobsite as approved.

2. Exterior panel color shall complement adjacent panels and shall be approved by the Owner. Sharp-angled horizontal front edges of panels shall be protected by brushed and coated stainless steel angled strip with concealed fasteners.

G. Size and Supports:

1. Panels shall be of sufficient size to adequately enclose all instruments designated as “panel-mounted” plus ample interior clearance to allow for installation, ventilation, operation, general servicing, and maintenance of the instruments. Weight of instruments shall be supported by Unistrut; or approved equal, channel supports. Panel size shall be as indicated on the Drawings or as required to include any approved substituted equipment.

2. Provide rigid supports for all devices. Supports shall not cause warping or bowing sides or mounting plates.

3. Should any approved panel equipment substitutions require a larger cabinet than shown on the Drawings, no additional cost shall be incurred by the Owner.

H. Mounting:

1. Attachment methods shall be detailed on panel fabrication Drawing submittals, and specified by manufacturer. Heavy panels shall be attached by anchor bolts to the concrete floor. Seismic restraints shall be installed as specified by the manufacturer.

2. Seismic anchorage shall conform to Section 13 05 41.

3. Mounting pans of rigid sheet steel shall be provided for interior components and accessories as required. A steel divider shall separate pneumatic sections from electrical sections. Devices having both electric and pneumatic connections shall be in the pneumatic section and connected to the electric section with waterproof flexible conduit.

I. Arrangement:

1. The instruments mounted in the panels shall have the nominal size and general arrangement shown. Panel layouts and nameplates shall conform to the approved submittal.

2. Space shall be provided for instruments indicated as furnished by others to be mounted and wired by the control panel manufacturer. These units shall be shipped to the control panel manufacturer in sufficient time for wiring. Coordination of instrument delivery shall be the responsibility of the Contractor. The instruments and controls to be located on each panel are shown on the instrumentation Drawings, electrical schematics, and/or in the individual Specification.

J. Ventilation:

1. The Contractor shall develop and provide panel heat calculations based on the Drawings and any changes in the project to the Engineer for favorable review.

2. Ventilation shall be provided to prevent internal panel temperatures from exceeding maximum equipment operating temperature, at a maximum exterior temperature of 100 degrees F.

3. Louvers shall be provided, when required for cooling, near the bottoms and tops on the rear doors and side of panels. 80-mesh screens shall cover the insides of the louvers.

4. Provide a thermostatically controlled fan in each enclosure when louvers cannot dissipate heat adequately or cause sufficient flow to all panel areas. Ventilation fans shall be low acoustic type suitable for control rooms. Provide removable, cleanable, or disposable dust filter for each remote site enclosure.

5. Provide heaters and circulating fans in all outdoor panels to prevent condensation.

6. Provide air exchange cooling system.

7. Provide air conditioning for IP-65/NEMA 4/4X panels requiring heat removal.

K. Cable Entry Plates:

1. For top entry panels, a gasketed 10-gauge-steel cover plate shall be cut that is suitable for the number of conduits. Cable entry plates are not required for bottom, side, or back conduit entry unless the Contractor must specifically control the position, size, and location of cutouts.

2. Cable entry plates shall mount to and be fastened along panel stiffeners and framing segments. Tee nut fasteners are preferred.

L. Signal Ground Buses:

1. Provide each panel with at least one isolated signal ground bus. Provide a bus 1-inch wide by 1/4-inch thick, running from top to bottom. Provide the bus with tapped holes to accommodate ground connections from various devices in the rack. Provide separate ground buses for analog and discrete/digital signals.

2. Connect all signal shield grounds within the panel to the ground bus(es) with ring-tongue connectors that bolt to the bus(es).

M. Signal Ground Plate: For rack, multiple enclosure, or bay systems, provide a separate 1/4-inch-thick isolated copper system ground plate. Mount this plate in a location central to all system components.

N. Panel Lights and Receptacles: Panels shall be internally lighted by LED lamps, provided with guards and a toggle switch, located convenient to each access door. One duplex GFI-type receptacle shall be provided in each panel section with its own circuit breaker.

2.02 PANEL HARDWARE

A. All doors shall be set flush with hardware required to meet the NEMA rating associated with the environment in which the panel will be installed.

B. Supply a minimum of two sets of keys. Doors shall be labeled with “AUTHORIZED PERSONNEL ONLY” in 1-inch letters.

C. Hinges shall be piano type. All hardware and handles shall be stainless steel.

D. Leveling adjustments on each panel section shall be provided on freestanding panels.

E. Provide a copy of the As-Built elementary control diagram(s) and wiring schematics for the control panel, enclosed in laminated plastic and mounted inside the panel.

F. Where noted on the Drawings, provide rack-out devices and access plates to make panel access easier and safer. Panel fabricators shall add full extension drawer guides and adjust width of front access plates to assure access to all components and hardware.

G. Floor-stand kits shall not exceed 24 inches in height nor cause the panel to exceed 84 inches in overall height.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install process control panels in accordance with manufacturer's recommendation and as follows:

1. Terminate all wiring between field devices and all related panels.

2. Ground the shield of instrumentation controls cable at one end only. Insulate the shield at the other end from the ground.

B. Install nameplates and identification tags to comply with Division 26 and as follows: Label the enclosures, devices, and components.

C. Touch-up and clean enclosures after the start-up.

3.02 START-UP AND TESTING

A. Start-up and testing is the responsibility of the process control panel supplier.

B. Coordinate startup and testing with the Software System Integrator (SSI). SSI tasks are not included in this specification and are performed under a separate Contract.

C. Submit a Control System test and commissioning Plan.

D. Provide start-up and testing of process control panels in conjunction with the equipment it controls and as specified in other sections of these Specifications.

E. Submit a Control System test and commissioning report.

END OF SECTION

SECTION 40 68 13
PROCESS CONTROL SOFTWARE

PART 1 – GENERAL

1.01 SUMMARY

A. This section defines the role of Hardware System Integrator (HSI) versus Software System Integrator (SSI) and identifies the process control software to be purchased by the Contractor's Hardware System Integrator (HSI).

1. The HSI is responsible for all hardware (PLCs, Control Panels, etc.) identified in this Contract and equipment required to make the hardware function as intended. Additional responsibilities include:

a. Installation and configuration of the hardware.

b. Configuration of the EtherNet/IP switches.

c. Configuration of the PLC communication (IP addresses) and I/O cards for scaling parameters.

d. Configuration and setting of parameters for instrumentation, valves, VFDs, and any devices needing parameters adjusted/configured to make them ready for process control and monitoring.

B. The process control software will be installed by Tulalip's designated SSI:

1. The SSI is responsible for loading the process control software onto the computer system hardware, programming the PLC specified in Section 40 63 43, and supporting the testing and commissioning of the process control software.

C. Tulalip will provide any new required servers and personal computers pre-configured to Tulalip's IT requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. The SCADA software will be:

1. Inductive Automation's Ignition Software – Latest version available at time of purchase. The following is the required Ignition modules:

a. Vision Module Unlimited.

b. Mobile Module.

c. Web Browser Module.

d. Reporting Module.

e. SQL Bridge Module.

f. Tag Historian Module.

g. OPC UA Server Module.

h. Allen Bradley Driver Suite.

i. Enterprise Administration Module.

B. The alarm management and notification software shall be:

1. Exele TopView – Latest version at time of purchase. The following is the required TopView plugins and hardware:

a. TopView Conversion from WIN-911 and SCADAlarm.

b. TopView Premium Voices.

c. IP-PBX for conversion from VOIP to analog phone service. Acceptable manufacturer: Grandstream UMC6202, or approved equal.

C. The PLC Software shall not be provided by the Contractor.

PART 3 – EXECUTION

3.01 CONFIGURATION AND PROGRAMMING

A. The SSI will install, configure, and program software in the new SCADA Server and SCADA Client PCs.

B. At the time of preparing this document, the Process Control Software recommended are specified in this section. Prior to Contractor procurement of the Process Control Software, it is recommended that the Contractor submit a list of software and consults with the Engineer and the SSI to verify the list of software for procurement.

3.02 TESTING AND COMMISSIONING

A. The SSI will develop and implement the following testing and commissioning test procedure:

1. Testing of the developed Process Control Software (SSI scope of work) will be performed at the same time of testing of the Process System Hardware (HIS scope of work) specified in these specifications.

2. Process Control Software:

a. Demonstrate that each network connected device installed under this Contract is properly installed and functioning.

b. Demonstrate that the SCADA software installation executed under this Contract has been installed and are functioning as intended.

c. Demonstrate that the SCADA software is properly communicating with each I/O point on each PLC or other devices and that the field data is available at all network nodes.

d. Demonstrate that all displays, trends, alarms, and reports have been configured and are properly operating.

e. Demonstrate that all real-time data is being collected as historical data and is accessible from PCs on the existing LAN.

f. Demonstrate that all control system configuration software is properly operating on the HMI workstation, and that the final configuration files can be uploaded, modified, and downloaded into the network attached control equipment.

g. Unless otherwise approved in writing, all testing shall be performed in the presence of authorized Tulalip Plant personnel from both the Operations and Maintenance.

h. Test forms consisting of an itemized list of items tested and demonstrated shall be prepared by the SSI for each system / system node testing prior to scheduling of each test.

i. These forms shall be completed at the time of witnessed testing and signed by both the SSI and the Tulalip Personnel.

B. The SSI shall prepare a final test report and submit it to the Tulalip.

END OF SECTION

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SECTION 40 70 00

INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Work Included:

1. Provide necessary tools, equipment, materials, supplies and labor required to complete the installation, startup, and operational testing of a complete and operable Instrumentation and Control (I&C) System as indicated on the Drawings and as specified herein, and as required to provide a complete and fully functional system.

2. Provide the necessary equipment components and interconnections along with the services of manufacturers' Engineering representatives necessary to ensure that the Owner receives a completely integrated and operational I&C system as specified herein.

3. Provide terminations and junction boxes for wiring at field mounted instruments, equipment enclosures, alarm, and status contacts.

4. Provide necessary Instrumentation and Control wire required for a fully functioning Instrumentation and Controls System as shown on the Drawings.

B. Work Specified in Other Divisions and Sub-Divisions:

1. The I&C Subcontractor is also referred to as the Hardware System Integrator in other Division 40 sections.

2. Process piping, installation of inline instrumentation, air compressors, main air supply headers, and other mechanical work and equipment.

3. General mechanical requirements as specified in Divisions 22 and 46.

4. Instruments and controls that are provided as part of a package system.

5. Refer to Division 26 Specifications for specific requirements for wire, conduit, grounding, and other electrical equipment.

6. Final control elements as specified in Division 40.

C. In addition to this section, comply with Section 40 61 13 for submittals, inspections, materials, nameplate, name tags, field mounted equipment, equipment location, painting, fasteners, and standards of quality.

1.02 REFERENCE DOCUMENTATION AND STANDARDS

A. American National Standard Institute (ANSI) Publications:

1. Y14.15a Drafting Practice.

B. International Society of Automation (ISA) Publications:

1. S5.4 Instrument Loop Diagrams.

2. S20 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

C. Manufacturer's data sheets, materials selection, and installation guidelines for the instrumentation specified in these Specifications and Drawings.

1.03 I&C SUBCONTRACTOR QUALIFICATIONS

A. An I&C Subcontractor shall be an electrical contractor who has demonstrated experience in purchasing, calibrating, fabricating, installing, and testing the Instrumentation and Control (I&C) products listed in this Specification section. Normally, the I&C Subcontractor is a systems house regularly engaged in the business of panel fabrication, control component procurement, programmable logic controller and personal computer (PC) application in the process control industry.

B. The I&C Subcontractor must have a minimum of 5 years of experience in performing every aspect of the type of work specified in this section and shown on the Drawings.

C. I&C Subcontractor shall be located within a 150-mile radius of the site.

1.04 I&C SUBCONTRACTOR SYSTEM RESPONSIBILITIES

A. General: The I&C equipment as specified in this Division shall be considered an integrated system. Entire system installation including calibration, verification, startup, operation testing, and training shall be performed by qualified personnel, possessing the necessary skills and equipment, and who have had experience performing similar installations. Instrumentation and control systems Drawings are diagrammatic only; it is the responsibility of the Contractor to obtain technical data, determine performance requirements, develop instrumentation detail installation designs, and coordinate the selection of specified equipment with Contractor supplied equipment to meet the design conditions stated.

B. Compatibility: See that components of the instrumentation system, including equipment specified under other divisions, are compatible and function properly as a system. Provide such additional equipment, accessories, etc., as are necessary to meet these objectives at no cost to the Owner.

C. Coordination: For control components, devices, and systems specified in other divisions, or shown on the Drawings:

1. Provide technical advice to mechanical and electrical subcontractors as necessary regarding their installation of instruments.

2. Verify the correctness of installation of instruments.

3. Verify that the proper type, size, and number of control wires with their conduits are provided.

4. Verify that the proper type, size, and number of pneumatic tubes with their conduits are provided.

5. Verify that proper electric power circuits provided for components and systems.

6. Resolve manufacturers' installation discrepancies between requirements and the detail requirements of the Drawings and Specifications.

7. Supervise final signal connections, both electric and pneumatic, to process instrumentation and control equipment.

8. Adjust, startup, and test process instrumentation and control equipment.

9. Provide specified documentation and training.

D. Performance: While the Drawings provide sufficient information to establish the form and function of the systems and their relationships, the responsibility for system integration and performance rests solely with the Contractor. The Engineer provides technical instruction and guidance where needed.

E. Site and Instrument Inspection: Inspect site for conformance to Drawings, paying special attention to space allocation and dimensions shown or required on Drawings. Inspect completed work and verify that it is ready for installation of instruments and equipment. Inspect each instrument and piece of equipment for damage, defects, completeness, and correct operation before installing.

1.05 SUBMITTALS

A. The following information described herein and in Section 40 61 13, paragraph 1.05, shall be submitted to the Engineer in accordance with Section 01 33 00, "Contractor Submittals." Submittals shall include the following:

1. Shop Drawings:

   a. Mounting information.

   b. Dimensions.

   c. Distances from fixed structures.

2. Loop Diagrams:

   a. Submit Instrument Loop Diagrams per ISA S5.4 to provide necessary detail for connection of analog instrument and control system components including those components specified in other sections of these Specifications.

   b. Provide with the Instrument Loop Diagrams instrument model numbers, ranges, set points, sizes, process fluids, specification reference numbers, and other information listed as "desirable and optional items of information" per ISA S5.4.

3. Specification Forms:

    a. Submit completed Specification Forms per ISA S20, including those instrumentation and control components directly related to process control, but specified in other divisions of these Specifications.

    b. Include on each form the assigned tag numbers, manufacturer's part numbers, and device data. More than one tag numbered item may be included on a sheet.

4. Instrument calibration forms.

5. Record Drawings.

6. Operation and Maintenance Manuals:

    a. Contents: Include log of factory setpoints/parameters changed for any device/equipment field adjustable value. Log to be divided up and grouped per device/equipment.

7. Accessory and Maintenance Materials.

8. Test Reports: Submit the following test reports as described herein:

    a. Instrument Calibration Data Sheets.

    b. Factory Testing of Control Panels.

    c. Instrument Verification Report.

    d. Final Operational Testing.

9. Demonstration and Final Operation Test Plan and Results.

1.06 QUALITY ASSURANCE

A. All process measurement devices of the same type to be provided by one manufacturer.

1.07 DRAWINGS

A. Drawings: The Instrumentation Drawings are diagrammatic; exact locations of instrumentation products shall be determined in the field by the Contractor and I&C Subcontractor, and approved acceptable by the Engineer. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict:

    1. Locations of equipment, inserts, anchors, motors, panels, pull boxes, manholes, conduits, stub-ups, fittings, power and convenience outlets, and ground wells are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.

    2. Review the Drawings and Specification Divisions of other trades and perform the instrumentation work that will be required for the installations.

3. Should there be a need to deviate from the Instrumentation Drawings and Specifications, submit written details and reasons for changes to the Engineer for favorable review.

4. The Drawings provide details of installation and supersede the manufacturer's recommendation where a conflict exists.

1.08 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 40 61 13, paragraph 1.08.

B. The Instrumentation Schedule at the end of this section lists pertinent information about instruments identified for the Contract. The Instrumentation Schedule is a listing of devices but shall not be construed as a Bill of Materials or as a complete listing. For example, equipment procured as a packaged unit or assembled in the field to perform a standardized function (such as water seals) may contain instruments that are not listed. Upon request, a copy of the database can be provided:

1. Other instruments on the pump skid assembly are provided by the pump skid manufacturer.

PART 2 – PRODUCTS

2.01 GENERAL

A. Manufacturer and model of instrumentation specified herein are identical to existing on-site equipment, or latest available model by same manufacturer at time of purchase. Contractor shall review field installation of existing instrumentation to verify same or similar installation. Installation includes Intrinsically Safety Barriers and other necessary ancillary equipment.

2.02 NAMEPLATES

A. Provide nameplate for each piece of equipment identifying the power source and the location of the power source.

2.03 EQUIPMENT OPERATING CONDITIONS

A. Equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:

1. Electrical Power: 120 Vac ±10 percent, 60 Hz, unregulated, except where specifically stated otherwise on the Drawings or in the Specifications, or when two-wire, loop-powered devices are specified.

2. Air: 85, +5, psig.

3. Field Instruments:

    a. Outdoor Areas:

        1) Ambient Temperature: -10 degrees F to +120 degrees F.

        2) Ambient Relative Humidity: 5 percent to 100 percent.

        3) Weather: Rain and sleet.

    b. Indoor Unheated Areas:

        1) Ambient Temperature: +35 degrees F to +120 degrees F.

        2) Ambient Relative Humidity: 5 percent to 95 percent, non-condensing.

    c. Indoor Environmentally Controlled Areas:

        1) Ambient Temperature: +60 degrees F to +104 degrees F.

        2) Ambient Relative Humidity: 10 percent to 90 percent, non-condensing.

2.04 ANALOG SIGNAL INDICATED UNITS

A. For instruments with local or remote indicators, provide indicators scaled in actual engineering units, i.e., gallons per minute, feet, psi, etc., rather than 0 to 100 percent, unless noted otherwise on the Drawings or Instrument Index.

2.05 SIGNAL TRANSMISSION

A. Analog: Signal transmission between electric or electronic instruments shall be 4-20 mA and shall operate at 24 Vdc. Signal output from transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating. Where practical, milliampere signals from the field shall be converted to a voltage signal at the external terminals of each panel, and instruments within a panel shall be parallel wired.

B. Nonstandard transmission systems such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted in the PLC I/O List or shown on the Drawings. When transmitters with nonstandard outputs do occur, their output shall be converted to 4-20 mA prior to transmission.

C. Discrete: Alarm and status signals shall be 120 Vac unless specified otherwise. Proprietary data highway or serial bit transmissions such as DeviceNet, Profi-bus, DNP3, etc. shall be allowed to the extent shown on the Drawings.

2.06 PANEL/RACK/ENCLOSURE BAY POWER SUPPLIES

A. For two-wire transmitters, provide a 24 Vdc regulated power supply from the appropriate control panel.

B. Manufacturer: Provide Phoenix Quint 100-240 ac/24 dc with terminal blocks and internal diodes for external connections, or approved equal.

2.07 INSTRUMENT CALIBRATION

A. Each field instrument shall be calibrated at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the instrument being calibrated. Such test instruments have accuracies traceable to the National Institute of Standards and Technology (NIST).

B. Submit a written report to the Engineer on each instrument. This report shall include a laboratory calibration sheet or the manufacturer's standards calibration sheet on each instrument and calibration reading as finally adjusted within tolerances.

C. The Contractor may, at their option, choose to perform calibration on an instrument by acquiring the services of an independent test lab, or by obtaining the required test instruments and performing the calibration.

2.08 FACTORY TESTING OF CONTROL PANELS

A. Fabricated equipment shall be tested before it leaves the factory. At the factory verify wiring continuity and equipment operation by simulating input and output.

B. Factory testing of control panels/devices/equipment shall be accomplished. Refer to individual Specification sections for tests requiring favorable review.

C. Upon completion of factory testing, submit a report certifying the control panels/devices/equipment are operable and meet the Specifications.

2.09 INSTRUMENTATION SCHEDULE

A. See Instrumentation Schedule found in Section 40 70 00.1.

2.10 INSTRUSPEC SHEETS

A. The following INSTRUSPEC sheets are included in this section:

INSTRUSPEC	INSTRUMENT DESCRIPTION
Gas Flow Measurement	Thermal mass flow meter, display and alarms
Liquid Flow Measurement	Electromagnetic flow meter, display and alarms
Pressure Measurement	Gage pressure transmitter, display and alarms
Dissolved Oxygen Measurement	Dissolved Oxygen concentration transmitter
Turbidity Measurement	Turbidity and suspended solids transmitter
Level Measurement	Ultrasonic level transmitter

INSTRUSPEC:	GAS FLOW MEASUREMENT
Instrument Description:	Thermal mass flow metering system.
Power Supply:	120 VAC (transmitter).
Signal Input:	Process.
Signal Output:	4 – 20 mA DC.
Product Requirements:	
General:	1. Flow meter shall be provided as a system consisting of a sensor and mounted converter/transmitter. 2. System shall be suitable for measuring air flow. 3. Locate per manufacturer's instructions for upstream and downstream obstructions. 4. Flow meter shall be rated for operation in Class 1, Division 1 areas.
Transmitter:	5. Acceptable Manufacturers: a. FCI ST98-11CT01CABBA. No substitutions.
Installation:	6. Install in accordance with manufacturer's instructions, API RP550, and the specified functional requirements. 7. Do not install the transmitter remotely.
Cable:	8. See Drawings for power and ground cable details.

INSTRUSPEC:	LIQUID FLOW MEASUREMENT
Instrument Description:	Electromagnetic flow metering system.
Power Supply:	120 VAC (transmitter).
Signal Input:	Process.
Signal Output:	4 – 20 mA DC.
Process Connection:	Flange, ANSI B16.5 Class 150, raised face for sizes below 24", AWWA Class D for sizes 24" or greater.
Product Requirements:	
General:	1. Magnetic flow meter shall be provided as a system consisting of a flow tube and remotely mounted converter/transmitter complete with all necessary interconnecting cables for the flow tube to transmitter separation shown. 2. System shall be suitable for measuring raw sewage flow. 3. Provide grounding rings for both upstream and downstream connections with the process piping. 4. Provide mechanical protection for the flow tube flanges and liner during installation or removal of the flow tube. 5. Provide pipe reducer and expander where pipe run size is different from specified flow tube size. The reducer and expander shall be uniformly diverging and converging swages with a total reducing angle not exceeding 8 degrees. Locate per manufacturer's instructions for upstream and downstream obstructions.
Flow Tube:	6. Flow tube construction: NEMA 4X construction. Liner material: Suitable for service hard rubber. Flow tube shall be rated IP68 when installed below grade or where submergence is possible. 7. Acceptable manufacturer: a. Siemens SITRANS FM MAG 3100W. b. No substitutions.
Transmitter:	8. Signal output 4 – 20 mA DC galvanically isolated and internally powered. 9. Power 120 VAC. 10. Enclosure: NEMA 4X wall mount. 11. Flow rate calibration as per Instrumentation Schedule. 12. Acceptable manufacturer: a. Siemens SITRANS FM MAG 5000. b. No substitutions.

INSTRUSPEC:	LIQUID FLOW MEASUREMENT
Installation:	13. Install in accordance with manufacturer's instructions, API RP550, and the specified functional requirements.
Cable:	14. Provide signal and coil cable between the primary element and transmitter by the system manufacturer. 15. A sufficient length of cable shall be provided for installation of a continuous run between the primary element and the remotely mounted transmitter.

INSTRUSPEC:	PRESSURE MEASUREMENT
Instrument Description:	Gage pressure transmitter.
Power Supply:	120 VAC (transmitter).
Signal Input:	Process.
Signal Output:	4-20 mA.
Product Requirements:	1. Electrodes shall be ASTM A276, type 316 stainless steel.
Acceptable Manufacturers:	2. Foxboro IGP10-T22D1F. 3. No substitutions.
Installation:	4. Install in accordance with manufacturer's instructions and the recommendations of API RP551. 5. Provide root valves at all process pressure taps. 6. Provide gage valves at the instrument where the instrument is not within sight of the root valve or where two or more instruments are connected to a single tap. 7. DO NOT connect safety instruments to the same process tap as instruments used for control, indication, or recording. 8. Locate pressure instruments as close as practical to the process tap and position to permit observation and maintenance from grade or a maintenance platform, unless otherwise specified. 9. DO NOT support pressure instruments from process piping. 10. Install testing and calibration ports.
Calibration:	Per Instrumentation Schedule.

INSTRUSPEC:	DISSOLVED OXYGEN MEASUREMENT
Instrument Description:	Dissolved Oxygen (DO) concentration analyzer system.
Power Supply:	14-50 VDC, 24 VDC nominal (transmitter).
Signal Input:	Process.
Signal Output:	4-20 mA, isolated and intrinsically safe.
Process:	Wastewater.
Process Connections:	Per installation detail.
Product Requirements:	
General:	The DO concentration analyzer system shall be a single point unit designed for fixed installation and shall include a sensor, transmitter, and accessories.
Sensor:	1. Range: 0-200% saturation or 0-20 ppm. 2. Power supply: Powered by transmitter. 3. Process Connection: 316SS gland fitting with nylon ferrule. 4. Temperature limit: 23° to 194°F (-5° to +90° C). 5. Dimensions: .75” diameter x 13.75” length.
Transmitter:	6. Enclosure: FM and CSA approved explosion proof. 7. Enclosure material: Stainless steel 8. Temperature limit: -22° to 284°F (-30° to +140° C) 9. Calibration: Microprocessor-based, able to retain configuration through power outage. 10. Analog Output signals: 4-20 mA. 11. Accuracy: +/- 1%. 12. Display: 24 alphanumeric character LCD, rotatable. 13. Approval: UL/FM/CSA. 14. Rating: Class 1, Div. 1, Groups A to D.
Cable:	6-conductor shielded, 300V rated. Maximum length: 1 mile.
Manufacturer & Model:	Sensor: ECD, DOS10-T23-CBL40-EG-75. Sensor cable: Belden 8786. Transmitter: ECD, T28. No substitutions.
Installation:	Install in accordance with manufacturer's instructions.
Calibration:	Per Instrumentation Schedule.

INSTRUSPEC:	TURBIDITY MEASUREMENT
Instrument Description:	Turbidity and suspended solids transmitter system.
Power Supply:	120 VAC (transmitter).
Signal Input:	Process.
Signal Output:	(1) 4-20 mA process signal. (1) 30 VDC failure alarm relay.
Process:	Wastewater.
Process Connections:	G1 thread, 3/4-inch FNPT.
Product Requirements:	
General:	Turbidity and suspended solids transmitter system shall be a single point unit designed for fixed installation and shall include a sensor, transmitter, and accessories.
Sensor:	1. Range: 0.000-9999 FNU, or 0.00-3000 ppm, or 0.0-3.0 g/l. 2. Power supply: Powered by transmitter. 3. Wetted materials: PVC, PPS G F40, Sapphire (wiper, rubber). 4. Temperature limit: -5° to +50° C. 5. Dimensions: 1.6” diameter x 8.7” length.
Transmitter:	6. Enclosure: NEMA 4X, wall or pipe mounted. 7. Calibration: Microprocessor-based, able to retain configuration through power outage. 8. Analog Output signals: 4-20 mA. 9. Accuracy: +/- 5%. 10. Approval: UL.
Cable:	7-conductor shielded. Maximum length: 200 m.
Accessories:	Turbidity sensor de-bubbler.
Manufacturer & Model:	Sensor assembly: ECD Triton TR8, part # 1398211-1. Transmitter: ECD, TR8, part # 1290100-1. No substitutions.
Installation:	Install in accordance with manufacturer's instructions.
Calibration:	Per Instrumentation Schedule.

INSTRUSPEC:	LEVEL MEASUREMENT
Instrument Description:	Ultrasonic level transmitter.
Power Supply:	120 VAC (transmitter).
Signal Input:	Process.
Signal Output:	4-20 mA.
Acceptable Manufacturers:	1. Siemens SITRANS, LU10. 2. No substitutions.
Installation:	3. Install in accordance with manufacturer's instructions and the recommendations of API RP551. 4. Provide root valves at all process pressure taps. 5. Provide gage valves at the instrument where the instrument is not within sight of the root valve or where two or more instruments are connected to a single tap. 6. DO NOT connect safety instruments to the same process tap as instruments used for control, indication, or recording. 7. Locate pressure instruments as close as practical to the process tap and position to permit observation and maintenance from grade or a maintenance platform, unless otherwise specified. 8. DO NOT support pressure instruments from process piping.
Calibration:	Per Instrumentation Schedule.

PART 3 – EXECUTION

3.01 PROCESS CONNECTIONS

A. Provide instrument impulse tubing to meet the intended process service and ambient environmental condition for corrosion resistance, etc. Install impulse tubing with a continuous slope according to service to promote self-draining or venting back to the process. Terminate connection to process lines or vessels in a service rated root valve, provided under other divisions that will permit closing off the impulse line or removal of the element without requiring shut down of the process. Include blowdown of drip legs and valves for terminations of impulse lines at the instruments.

B. Process vessels, line penetrations, and root valves shall be furnished and installed under other divisions of these Specifications. Instrument tubing and valve manifolds are installed as part of this Specification.

3.02 FIELD WIRING

A. Ring out signal wiring prior to termination and perform surge withstand tests where required. Verify wire number and terminations are satisfactory as designated on the Loop and Interconnect Diagrams. Verify terminations are tight and shields are uniformly grounded at one location.

3.03 SIGNAL GROUNDING

A. Proper grounding of equipment and systems in this division is critical, since computer and associated networks and peripherals are involved. The Drawings and Division 26 specify grounding for equipment in this Division.

B. A single-point grounding system for instrument signals is required for instrument panels. This instrument single point grounding system does not use building steel or conduit systems for its ground path.

1. Ground signal shields, signal grounds, and power supplies at an isolated signal bus within each instrument panel, rack, or enclosure. The shields at the far ends of these signal cables must be disconnected (floated) from any ground to prevent ground loops.

2. Do not connect the rack or enclosure frames to the signal grounding buses.

3. Connect each isolated signal ground bus within each panel using a stranded, insulated copper wire of size 6 AWG or larger directly to a system ground rod installed per the Drawings.

C. If more than one instrument panel or rack is installed side-by-side, locate an isolated system grounding plate in one of the panels:

1. Connect the isolated signal buses in such instrument panel or rack radially to the system ground plate using a stranded, insulated copper wire of size 8 AWG or larger.

2. Do not use conduit, cable raceways, or building steel to distribute the grounding connections; use dedicated wires as specified above. Install a single conduit

containing a #2 AWG insulated ground wire from the insulated grounding plate directly to a system ground rod installed per the Drawings.

3.04 PERFORMANCE TESTING AND OPERATIONAL TESTING

1. System Verification Testing and Performance Testing: Verify that each instrument shown on the Instrumentation Schedule is operating and calibrated as specified in the Instrumentation Schedule by simulating inputs at the primary element in each system loop and verify performance at loop output devices (i.e. recorder, indicator, alarm, etc., except controllers). Simulate inputs at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span or with on-off inputs, as applicable.

3.05 CHANGES FROM FACTORY DEFAULTS

A. Provide log grouped by device/equipment to document changes in values to factory default setpoints/parameters.

END OF SECTION

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SECTION 40 70 00.1

INSTRUMENTATION SCHEDULE

I/O Tag	Loop number	Sheet	Type	Range	Provided By	INSTRUSPEC	Type	Notes
PE/PT	2134	P201	AI	0 – 600 PSIG	Kubota	Pressure Measurement	Pressure Meter with Integral Transmitter	See Drawings for size
FE/FIT	2133	P201	AI	5 – 2000 FPS	Kubota	Gas Flow Measurement	Thermal Mass Flow Meter with Transmitter	See Drawings for size
FE/FIT	2433	P202	AI	5 – 2000 FPS	Kubota	Gas Flow Measurement	Thermal Mass Flow Meter with Transmitter	See Drawings for size
PE/PT	2434	P202	AI	0 – 600 PSIG	Kubota	Pressure Measurement	Pressure Meter with Integral Transmitter	See Drawings for size
FE/FIT	2104	P203	AI	1 – 30 FPS	Contractor	Liquid Flow Measurement	Electromagnetic Flow Meter with Transmitter	See Drawings for size
FE/FIT	2313	P204	AI	1 – 30 FPS	Contractor	Liquid Flow Measurement	Electromagnetic Flow Meter with Transmitter	See Drawings for size
X	2504	P205	AI	0.00 – 3000 PPM	Kubota	Turbidity Measurement	Turbidity Meter with Transmitter	See Drawings for size
X	2505	P205	AI	0.00 – 3000 PPM	Kubota	Turbidity Measurement	Turbidity Meter with Transmitter	See Drawings for size
X	2604	P206	AI	0.00 – 3000 PPM	Kubota	Turbidity Measurement	Turbidity Meter with Transmitter	See Drawings for size
X	2605	P205	AI	0.00 – 3000 PPM	Kubota	Turbidity Measurement	Turbidity Meter with Transmitter	See Drawings for size
DOE/ DOT	1803	P101	AI	0 – 20 PPM	Contractor	Dissolved Oxygen (DO) Measurement	DO Concentration Meter with Transmitter	
LE	1603	P101	AI	0-XX FT	Contractor	Level Measurement	Ultrasonic Level Transmitter	

END OF SECTION

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SECTION 40 78 00
PANEL MOUNTED INSTRUMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide panel mounted instrumentation and control, as specified herein, the Drawings, and as needed for a complete and proper installation.

1.02 REFERENCED STANDARDS

Reference	Title
NEMA 250	Enclosures for Electrical Equipment (1,000 volts maximum)
NEMA ICS 1	Industrial Controls and Systems: General Requirements
NEMA ICS 2	Industrial Controls and Systems: Controllers, Contactors, and Overload Relays, Rated 600 Volts AC
NEMA KS 1	Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

1.03 SUBMITTALS

A. The information described in this section and in Section 40 61 13, paragraph 1.05, shall be submitted to the Engineer in accordance with Section 01 33 00, “Contractor Submittals”.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide panel mounted instrumentation and control equipment of manufacturer and model as specified in the Drawings.

B. Products shall be classified for the following locations, unless otherwise specified:

1. Indoor Locations: NEMA 12.

2. Outdoor Locations: NEMA 3R or 4.

3. Corrosive Areas: Nonmetallic NEMA 4X.

4. Hazardous Areas: NEMA 7.

2.02 CONTROL DEVICES

A. Pushbuttons:

1. 30.5 mm flush head, heavy-duty, with NEMA rating to match enclosure type.

2. Operators: Red for stop functions and black for all other functions.

3. Provide pushbuttons designated “Lock-Out-Stop” (LOS) with a padlockable attachment to maintain the device in a depressed (stop or open) position.

4. Escutcheon legend as specified on the Drawings.

5. Unless otherwise specified, use momentary contact type.

6. Contact Blocks:

    a. NEMA ICS 2 designation A600 except when switching circuits monitored by programmable controllers or other solid state circuits.

    b. Hermetically sealed, logic-read type.

    c. Acceptable Manufacturer:

        1) Allen-Bradley.

        2) Square D.

        3) Or approved equal.

B. Selector Switches:

1. 30.5 mm heavy-duty, with NEMA rating to match enclosure type.

2. Unless otherwise indicated, contact blocks and number of positions as required to perform the specified operations.

3. Contact Blocks: Rated as specified in this section.

4. Escutcheon Legend: As indicated on the Drawings.

5. Acceptable Manufacturer: Where solid state loads are switched, and the indicated contact development cannot be obtained with logic-read type contacts:

    a. Blue Line with Type D contacts.

    b. Or approved equal.

C. Indicating Lights:

1. Indicating Lights: 5 to 6 VDC light emitting diodes (LEDs) with autotransformer and push-to-test feature.

2. Testing: As a group using a common lamp test button.

3. Indicating Light Colors: Per Drawings.

4. Heavy-duty, with NEMA rated socket/wiring to match enclosure type.

D. Control Stations:

1. Pushbuttons: Protective Hypalon boots.

2. When indicating lights are specified, size to accommodate the transformer type lights.

3. Acceptable Manufacturer:

a. Allen-Bradley, 800 H series.

b. Crouse-Hinds, NCS series.

c. Or approved equal.

2.03 CONTROL RELAYS

A. Load-switching Control Relays:

1. When used for switching loads (solenoids, actuators, contactors, motor starter coils, etc.): Heavy-duty machine tool type.

2. Relays that have contacts used for remote interlocking or when the switching load is not shown: Heavy-duty machine tool type.

3. Contacts: As a minimum, 4-pole and field interchangeable to either normally open or normally closed. Relay shall be capable of accepting a 4-pole adder.

4. AC Relays: NEMA A600 contact ratings and electrical clearances for up to 600 volts.

5. DC Relays: NEMA P300 contact ratings and electrical clearances for up to 250 volts.

6. Acceptable Manufacturer:

a. Allen Bradley Bulletin 700.

b. Square D Class 8501.

c. Or approved equal.

B. Logic Level Switching Control Relays:

1. Minimum of three SPDT, gold-flashed, fine silver contacts rated 3 amps resistive at 120V AC or 28V DC.

2. Plug-in type with heavy-duty, barrier-protected screw terminal sockets and clear polycarbonate dust cover with clip fastener.

3. AC Models: Neon lamp indicator wired in parallel with coil.

4. Acceptable Manufacturer (Control relays used for switching solid-state logic and signal circuits):

    a. Allen Bradley or Potter Brumfield series KUP.

    b. Or approved equal.

C. Latching Relay:

1. Electrically actuated latching relay or an industrial relay with an electrically operated latching attachment.

2. Latching Mechanism: One SET coil and one RESET coil rated for continuous duty on 120 VAC, or as otherwise shown on the Drawings.

3. Maintain the last state upon a power failure.

4. Contacts: Rated B300 and hermetically sealed in a glass envelope.

5. Normally open and normally closed as shown on the Drawings.

6. Acceptable Manufacturer:

    a. Allen-Bradley.

    b. Cutler-Hammer.

    c. Or approved equal.

D. Timers:

1. Timing Relays:

    a. Solid-state, pulse count type using a high frequency RC oscillator and integrated circuit counter for timing.

    b. Do not use electrolytic capacitors in the timing circuits.

    c. Time delays from 0.1 seconds to 48 hours, adjustable over a 20:1 range.

    d. Timing adjustment: Knob adjustment on the top of the unit.

    e. On-delay, off-delay, and single-shot timing models.

    f. Reset in 0.03 seconds or less.

    g. Timer Accuracy: Plus or minus 2.0 percent under normal conditions.

    h. Two NEMA form-C timed contacts.

i. Acceptable Manufacturer:

1) Agastat, STA series.

2) Agastat BTSAIISC with locking bail STAOOI if equal socket.

3) General Electric

4) Or approved equal.

2. Motor-Driven Timers:

a. Mounted in a one-piece molded case, permanently mounted and wired.

b. Driven by a synchronous motor which starts timing when initiated by an external signal.

c. Time Settings: Made by turning a knob on the front of the dial.

d. Neon pilot light visible from the front of the timer shall glow red when the timer motor is energized.

e. Visual indication by a cycle progress pointer which advances to zero from the setting back to zero as time progresses.

f. Two sets of “instantaneous” NEMA form-C contacts which actuate when the timing is initiated.

g. One set of “delayed” NEMA form-C contacts which actuates when the unit has timed out.

h. Reset: Unless otherwise indicated, when the timing cycle is completed, timer automatically resets.

i. Acceptable Manufacturer:

1) Eagle Cycle-flex reset timer HP5 series.

2) Automatic Timing Controls Series 305E.

3) Or approved equal.

2.04 MAGNETIC CONTACTORS

A. Lighting Contactors:

1. Electrically held contactors used to switch current to incandescent filament, fluorescent and high intensity discharge lamp loads.

2. Rated 600V AC, 60 hertz.

3. Coil Voltage Contact Rating and Number of Phase: As specified.

B. Motor Contactors:

1. Designed for continuous operation of induction motors at 600 volts or less at 60 Hz and comply with NEMA ICS 2-321.

2. Minimum Contactor Size: Unless otherwise indicated, NEMA size 1.

3. Supply the contactor with a normally open auxiliary contact for use as a hold-in contact as a minimum. Provide additional contacts as indicated.

4. Additional contacts as needed.

5. The coil voltage, frequency, and number of poles to be as specified.

2.05 SAFETY DISCONNECT SWITCHES

A. Heavy-duty, safety type rated 600 volts AC complete with current limiting fuses sized to match switch ampere rating.

B. Operating Handle: Capable of being padlocked in the “off” position.

C. Operator: Positive, quick-make, quick-break mechanism.

D. Switch Mechanisms: One auxiliary contact rated B150, per NEMA ICS 2-125, that opens before the switch blades.

E. Horsepower rated for motors and comply with NEMA KS 1.

F. Defeatable door interlocks that prevent the door from opening when the operating handle is in the “on” position.

G. Switches shall have line terminal shields.

H. Acceptable Manufacturer:

1. Westinghouse Type H-600.

2. Cuttler Hammer.

3. General Electric.

4. Siemens.

5. Square D.

6. Or approved equal.

2.06 MANUAL STARTERS

A. Manual Starters:

1. Horsepower rated quick-make, quick-break, toggle mechanism together with 1 or 2 overloads as specified.

2.07 OVERCURRENT PROTECTION

A. Circuit Breakers:

1. Thermal magnetic, molded-case type with the ampere rating as specified.

2. Unless otherwise indicated, circuit breaker interrupting rating:

a. 10,000 amperes symmetrical minimum for service at 240 volts and below.

b. 22,000 amperes symmetrical minimum for service above 240 volts.

2.08 ELAPSED TIME INDICATORS

A. Panel-mounted, non-resettable, six digit, hour indicator, rated 120 volts AC, 60 Hz.

2.09 TEMPERATURE TRIP RELAY

A. Capable of monitoring electric motor winding temperatures based on input signals from three 10 ohm copper 3-wire resistance temperature detectors (RTD).

B. Equipped with light emitting diodes (LED) to indicate which RTD is at the highest temperature. The highest temperature shall be internally compared to two trip settings to trip SPDT output relays. The output relays shall be settable at different temperatures and shall de-energize at the set point on increasing temperature.

C. Relay Contact Minimum Rating: 240 VAC, 5A non-inductive.

D. Output Signal: 0 to 1 mA, linearly proportional to the temperature of the hottest RTD.

E. Powered by 120 VAC, 60 Hz.

F. Acceptable Manufacturer:

1. Allen Bradley

2. Cuttler Hammer

3. Or approved equal.

2.10 SPEED ADJUSTMENT POTENTIOMETER

A. Single-turn, heavy-duty potentiometer.

B. Molded resistance track rated at 2 watts 500 volts. Resistance value: As shown on the Drawings, or if not shown, then suitable for the application.

C. Equipped with a positive positioning feature to prevent backlash and movement due to vibration.

D. Bushing mounted using a NEMA Type 13 oiltight mounting. Include a legend plate with graduated markings from 0 to 100 percent and the word “SPEED.”

E. Acceptable Manufacturer:

1. Cuttler Hammer

2. Allen-Bradley 800T.

3. Or approved equal.

2.11 SELECTOR SWITCHES

A. For Fans: 600V, heavy duty two-position, four-circuit, suitable for Class 1, Division 2 area.

B. Indicating Plate Markings as Follows: “Enable-Stop.”

C. Acceptable Manufacturer:

1. Appleton.

2. Crouse-Hinds EDS 21272.

3. Or equal.

PART 3 – EXECUTION

3.01 GENERAL

A. Mount control stations, contactors, and safety disconnect switches 48 inches above finished floor.

3.02 FIELD CHECKOUT AND TESTING

A. Checkout each miscellaneous electrical device for:

1. Proper mounting.

2. Proper interconnections.

3. Absence of shorts and grounds.

4. Proper function of motor start and control equipment.

5. Power supply.

6. Field devices.

B. Checkout Systems:

1. Proper interconnections.

2. Absence of shorts and grounds.

C. Field Testing: To be provided as part of the system and operational testing:

1. Test all products per Section 40 61 13.

END OF SECTION

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Division 41

Material Processing and Handling Equipment

SECTION 41 22 23

HOISTS AND CRANES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies, monorail hoists and cranes for the maintenance hoists to be installed on this project.

2. Furnish units complete with all appurtenances, which are required for proper and safe operation.

3. Fabricate, assemble, erect, and place all specified equipment in proper operating condition in full conformity with Drawings, Specifications, and manufacturer's recommendations.

4. Provide load tests and certification for the rated loads.

1.02 DESIGN STANDARDS

A. The hoists/cranes shall be the Manufacturer's normal design for the services specified. Standard replacement parts shall be readily available. The design, materials, and fabrication of the cranes shall comply with the latest Codes and Standards referred to herein.

B. Construction and Manufacture:

1. Equipment furnished under this section shall comply in all respects with the requirements of the following standards:

a. Monorail System: Specifications for Underhung Cranes and Monorail Systems, ANSI MH27.1 and ANSI B30.11.

b. Hoist: ANSI B30.11, Hoist Manufacturers' Institute.

c. Trolley: ANSI MH27.1.

d. Chain Hoist Service Class: ANSI HST 1M.

e. Hook: ANSI 30.10.

f. Stress and Safety Factors: ANSI MH27.1 and ANSI B30.11. Properly select materials of construction for stresses to which subjected.

g. Safety of Operation, Accessibility, Interchangeability, and Durability of Parts: ANSI B30.

h. CMAA: Crane Manufacturer's Association of America: CMAA Specifications Nos. 70 and 74.

i. HMI: Hoist Manufacturer's Institute.

j. NEMA: National Electric Manufacturer's Association.

k. NEC: National Electric Code.

l. OSHA and/or WISHA Standards.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00, "Contractor Submittals".

B. Shop Drawings and Equipment Data:

1. Manufacturer's catalog data and certification confirming rated capacities.

2. Complete catalog information, descriptive literature, materials of construction, and specifications on hoist, wheels, gears and bearing, hook, and accessories.

3. Dimensional drawings and details for hoist.

C. Operations and Maintenance:

1. Equipment function, normal operating characteristics, and limiting conditions.

2. Assembly, installation, alignment, adjustment, and checking instructions.

3. Lubrication and maintenance instructions.

4. Parts list and predicted life of parts subject to wear.

5. Outline, cross-sections, assembly drawings, and engineering data.

D. Operation and maintenance manuals shall be in accordance with Section 01 78 23, "Operation and Maintenance Data," and in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1.04 PROTECTION

A. Protect all equipment during shipment, handling, and storage.

B. Painted Surfaces:

1. Protect against impact, abrasion, discoloration, and other damage.

2. After installation, repaint or touch up all painted surfaces that are scratched or damaged, prior to final acceptance.

1.05 QUALITY ASSURANCE

A. Certification:

1. Manufacturer's certification that equipment is capable of lifting the specified capacity with an acceptable industry safety factor.

2. On-site load test to 125 percent of rated load in accordance with OSHA/WISHA requirements.

B. Factory test all drives and hoists.

1.06 WARRANTIES

A. Provide a 1-year equipment warranty as specified in the Special Provisions.

PART 2 – PRODUCTS

2.01 HOIST SCHEDULE

EQ Number	Description	Specification Section	Capacity (tons)	Travel (feet)	Lift (feet)
NA	Effluent Pumps Manual Hoist	2.02	2	66	20
NA	Permeate Pump Maintenance Hoist	2.06	1	NA	8
NA	Headworks Fine Screen Davit Crane	2.07	1	NA	9
NA	Portable Hoist	2.08	–	–	29

2.02 MANUAL MONORAIL HOIST

A. Equipment Name: Effluent Monorail Hoist.

B. Type: Underhung monorail hoist.

1. Hoist Type: Manual chain, low head room, with chain operated geared trolley.

C. Crane Duty Class: Class C Moderate Service.

D. Rated Capacity (minimum):

1. Hoist: 2 tons (4,000 pounds).

E. Dimensions:

1. Maximum Lift: 20 feet – 0 inches.

F. Other Features and Accessories:

1. Swivel hook with safety latches.

2. Rated capacity of the hoist clearly marked.

3. Chain bucket to hold full length of chain, attached to hoist.

4. Geared trolley continuous chain loop to extend to within 4 feet of floor surface.

2.03 PRODUCTS

A. Hoists:

1. Hoist shall be of types described above as manufactured by:

a. Yale or Coffing by Duff-Norton Company.

b. CM Columbus McKinnon.

c. Or Equal.

2.04 MATERIALS

A. Chain: Steel.

B. Trolley: Steel, ASTM A36.

C. Wheels: Cast Iron or Steel.

D. Hooks: Forged Steel.

2.05 EQUIPMENT

A. Hoists and Manual Trolleys:

1. Standard headroom chain hoists, with manual trolleys, adjustable to American Standard I beams.

2. Cast Iron Wheels: Heat-treated and equipped with sealed, lifetime lubricated precision ball bearings for long life.

B. Painting:

1. Hoist and Trolley: Factory painted per manufacturer's standards.

2. Monorail Beam: Galvanize in accordance with Section 05 51 16, "Galvanizing."

2.06 PERMEATE PUMP MAINTENANCE HOIST

A. Equipment Name: MBR Pump Maintenance Hoist.

B. Type: Foldable Shop Hoist:

1. Phenolic wheels for portability and positioning.

2. Foldable for storage.

3. Manually operated hydraulically operated telescoping boom.

C. Rated Capacity (minimum):

1. Hoist: 1 ton (2,000 pounds), with boom extended to a minimum height of 100 inches from floor.

D. Acceptable Product:

1. Ruger Industries RC2000K, as manufactured by The David Round Company, www.rugerindustries.com, 800-535-2725.

2. Similar product with reach and load capacity as specified with approval of Owner's Representative.

2.07 HEADWORKS FINE SCREEN DAVIT CRANE

A. Equipment Name: Headworks Fine Screen Davit Crane.

B. Type: Floor Mounted Davit Crane.

1. Pedestal base mounted to top of concrete slab that allows rotation of boom.

2. Demountable mast and boom allowing removal.

3. Manually operable hoist and boom adjustment.

4. Type 304 Stainless Steel construction for corrosion resistance.

C. Rated Capacity (minimum):

1. Hoist: 1 ton (2,000 pounds), with boom extended to a minimum reach of 48 inches.

D. Acceptable Product:

1. Commander 2000 (model 5PT20), as manufactured by Thern, Inc., www.thern.com, 800-843-7648.

2. Similar product with reach and load capacity as specified with approval of Owner's Representative.

E. Installation:

1. Crane shall be mounted on the concrete slab between the existing Fine Screen and the New Fine Screen to be able to swing and lift either screen's basket end from the troughs.

2. Final location shall be approved by Owner's Representative prior to mounting.

3. Attach pedestal base to slab with 316 Stainless Steel epoxy anchors, size and embedment to suit pedestal mounting holes and manufacturer's load requirements.

2.08 PORTABLE HOISTS

A. Provide one portable hoist Halliday DB, or approved equal, for use with the Drain Pumps and Anoxic Mixer. Hoist base must match existing hoist bases installed at the facility.

B. The portable hoist shall be all T-304 stainless steel construction with marine grade brake winch and 30 feet (9 meters) of 1/4-inch (7 millimeter) T-304 stainless steel cable with galvanized safety hook. The davit arm shall adjust in 1-inch increments from 24 to 36 inches.

C. Provide and install stainless steel flush floor mount sleeves (Halliday D1R Lined or approved equal) at locations indicated on Drawings with Sleeve Caps to keep debris from entering sleeve mount.

D. Hoist Lifting Capacity: 360 pounds with 24-inch to 36-inch fitting reach.

E. Provide 1/4-inch by 30-foot stainless wire cable with mounting bracket, pulley, and stainless grip eye connection (Flygt or approved equal).

F. Provide mounting hardware and Mount Sleeve.

1. Equipment furnished under this section shall comply in all respects with the requirements of the following standards:

a. Wire Rope Hoist Service Class: ANSI HST 4M.

b. Chain Hoist Service Class: ANSI HST 1M.

c. Hook: ANSI B30.10.

d. Stress and Safety Factors: ANSI B30.11. Properly select materials of construction for stresses to which subjected.

e. Safety of Operation, Accessibility, Interchangeability, and Durability of Parts: ANSI B30.

f. OSHA and/or OSSC Standards.

PART 3 – EXECUTION

3.01 INSTALLATION AND INSPECTION

A. Inspect structure and crane rail beam erection for conformance with reviewed Shop Drawings and Contract Documents prior to installation of equipment. Correct or replace nonconforming work prior to proceeding with installation.

B. Cranes and hoists shall be installed in conformance with manufacturer's instructions and inspected by a manufacturer's representative. Provide all necessary accessories to make monorail complete, usable, and capable of meeting the operating requirements specified in the Operating Requirements. Test, adjust, and clean equipment for acceptance by Owner.

3.02 TESTING

A. Crane and hoist equipment shall be operated through a complete lift and lowering cycle and through a complete travel of the trolley and/or bridge to determine that the equipment shall perform smoothly and safely and that pendant cable length is sufficient to permit operation from desired floor levels. All tests shall be carried out with the hoist loaded at 125 percent of capacity. The Contractor shall provide the test weight loads. Contractor shall provide certification of load test to Owner signed by a Crane Professional. Any defects shall be corrected by the Contractor without any expense to the Owner.

3.03 USE BY CONTRACTOR

A. Hoist used by the Contractor shall be repaired, repainted, and otherwise refurbished to like-new condition prior to its acceptance. The Contractor assumes all responsibility for operation and maintenance until the hoist has been accepted.

3.04 TRAINING AND ORIENTATION

A. Contractor shall arrange and conduct a training and orientation for facility maintenance personnel and staff users. Two sessions of 2 hours each shall be conducted and shall cover operation, maintenance, and safety features of the hoisting equipment; questions and answers; and hands-on demonstration.

B. Provide Manufacturer's Installation Certification. See form in Section 01 99 90, "Reference Forms."

3.05 CLEANUP

A. Upon completion of work, area shall be cleaned and restored to original condition, acceptable to the Owner.

END OF SECTION

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Division 46

Water and Wastewater Equipment

SECTION 46 11 22
SUBMERSIBLE MIXERS

PART 1 – GENERAL

1.01 SUBMITTALS

A. Product Data:

1. Model number. Unit must be the same as the existing Flygt units.

2. Catalog information, descriptive literature, specifications, and identification of materials of construction.

B. Shop Drawings:

1. Dimensional Drawings, Layout, and Installation Drawings.

2. Power and control wiring diagrams.

3. Detailed information on structural, mechanical, electrical, or other modifications necessary to adapt the arrangement or details shown to the equipment furnished.

C. Quality Control Submittals:

1. Shipping, storage and protection, and handling instructions.

2. Manufacturer's installation instructions.

3. Manufacturer's Installation Certification.

D. Closeout Submittals: Operation and maintenance manuals.

1.02 QUALITY ASSURANCE

A. Manufacturer's qualifications: Minimum 5 years of experience.

PART 2 – PRODUCTS

2.01 MIXERS

A. Direct drive propeller mixer suitable for mixing raw wastewater and mixed liquor at 17,000 mg/L solids concentration. Flygt 4640X 4 HP. Prop code 083707SF.

B. Entire unit designed for continuous operation completely submerged in the liquid.

C. Double, independent mechanical shaft seals with silicon carbide faces.

D. Bearings sized to provide B10 life of 100,000 hours, minimum.

E. Materials:

1. Propeller: ASTM 316 stainless steel.

2. Motor Housing: Stainless steel.

3. Shaft: ASTM 316 stainless steel.

4. Fasteners and Hardware: ASTM 316 stainless steel.

5. Lubricating oil shall be paraffin based, FDA approved.

F. Cantilever Guide Bar Mounting System:

1. Adjustable for depth, horizontal angle, and vertical angle.

2. Coordinate with Contractor to verify mixer can operate with existing guide bar. If not, Flygt shall provide Type 316 or 304 stainless steel mast, brackets, fasteners, cable or wire rope, chains, and bearings.

3. Suitable for anchoring to concrete as shown.

4. Unit to be provided with a grip eye lifting system

5. Lifting system shall be compatible with portable hoist system specified in Section 41 22 23, “Hoists and Cranes”. A short section of chain at the mixer and an automatic release chain pick device shall be utilized so that the mixers can be pulled using the portable hoist.

G. Motor:

1. Explosion proof, Class 1 Division 1.

2. 480-volts, three-phase, 60-Hertz power supply.

3. Class F insulation.

4. NEMA B design.

5. Provide 40-foot minimum, submersible power cable with cable gland, cable protection, and traction strain relief. Cable connection shall ensure watertight motor compartment even if cable is severed while submerged to a depth of 35 feet.

6. Provide thermistor-type overload protection.

7. Provide moisture sensor and shutdown protection.

8. Contractor to confirm in writing that motor feeder cable length will not require filter to protect motor.

2.02 PERFORMANCE

A. Mixer shall provide complete mixing for a basin area of 21 feet by 21 feet with water depths between from 16.5 feet to 24 feet. Maximum process flow rate through the basin is 4.5 mgd.

1. Nominal “pumping rate” shall be 4,300 gpm, minimum.

2. Minimum motor horsepower equals 4 hp.

3. Motor/propeller speed equals 855 rpm.

2.03 MANUFACTURER’S WARRANTY

A. Mixer, motor, and accessories shall be warranted for 5 years from date of Installation Certificate signature.

2.04 CONTROLS

A. The Tulalip Plant will be controlled via a Plant-Wide Programmable Logic Controller (PLC) system. Therefore, individual control panels or systems do not have to be provided by the mixer manufacturer.

B. Special Controls: If mixer-specific controls are required, for example the moisture sensor relay, then these shall be provided by the mixer supplier for incorporation into the main PLC system. See Drawing E9.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s printed instructions.

B. Provide hooks and tie-offs for cables, lifting cables, and chains for easy access within 6 inches of the top of the tank.

C. Provide preset lengths of stationary cable in order to set the mixer shaft centerline at the following elevations:

1. 8 feet above finish floor.

2. 10 feet above finish floor.

3. 12 feet above finish floor.

3.02 FIELD QUALITY CONTROL

A. Functional Tests:

1. Alignment: Test installed assemblies for correct rotation, proper alignment and connection, and quiet operation.

2. Vibration Test:

    a. Test installed unit in normal operation at various water levels and mixer positions.

    b. Maximum peak-to-peak vibration amplitude: 3 mils. Provide mixer vibration test report.

    c. Adjust or modify as necessary if unit exhibits vibration more than limit specified. Replace units that cannot be adjusted or modified to conform as specified.

3. Demonstrate that the portable hoist supplied for the pumps and mixers is capable of removing and reinstalling the mixers without requiring the operator to enter the sump.

B. Electrical Test:

1. Provide electrical measurements of the motor during the functional test when the mixer is operating at rated conditions. Record and submit to Owner.

2. Measure and record amps, volts, and kilowatts in each phase.

3. Provide an electrical test report listing the measured values over a 15-minute period of operation.

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. One-half day for installation assistance and inspection.

2. One-half day for testing, completion of Manufacturer's Installation Certification, and training.

END OF SECTION

SECTION 46 11 30

MBR EQUIPMENT AND INSTRUMENTS

PART 1 – GENERAL

1.01 KUBOTA MBR

A. Schedule A shall include "Submittal During Construction." See Bid Proposal Form for payment. The remainder of Kubota MBR supply shall be included in Schedule B.

B. The Kubota MBR System was selected for this project. No other MBR system will be considered. Refer to the following Kubota submittal information provided in Appendix C:

1. Kubota MBR proposal.

2. MBR Drawings.

3. Kubota Terms and Conditions (for reference).

4. Equipment and instrumentation information.

5. Equipment unloading instructions.

C. **General Construction Contractor shall** allow Kubota a minimum of 6 weeks to prepare their MBR equipment “Submittals during Construction” (see subsection 1.03), after Kubota has been issued a Purchase Order to provide this submittal.

D. **General Construction Contractor shall** allow Kubota a minimum of 4 months to manufacture and ship all the MBR equipment, included in their scope of supply, after the “Submittals during Construction” has received a “No Exceptions Taken” or “Make Corrections Noted” review COMMENTS from Parametrix. Contractor should allow time for the initial Kubota Submittals during Construction and also a resubmittal of revised Submittal during Construction.

E. **General Construction Contractor shall** allow Kubota, over a period of 5 weeks, time to assist with MBR equipment installation and certify their equipment has been installed correctly.

F. **New Kubota EK400 cassettes** must be able to connect to existing diffuser cases, existing cassette guide rails and existing air and permeate pipes. The staged construction will require installing existing Kubota cassettes from existing MBRs into the new MBRs where they will provide complete wastewater treatment for a 1- to 2-month period.

1.02 DESCRIPTION

A. This section specifies the supply of equipment for the Membrane Bioreactor System (MBR) and associated services. Mechanical and electrical equipment furnished shall include but not be limited to the following equipment:

1. EK400 Membrane cassettes/modules, racks, supports, railings, and frames for two existing MBR tanks.

2. In-basin permeate collection header pipes/connections, hangers, and supports.

3. In-basin air scour and diffuser cleaning pipes/connections hangers, and supports.

4. Air scour diffusers and supports.

5. Permeate pump flow control valves.

6. Instruments as noted in this specification and the Kubota drawings.

7. Valves and operators as noted in this specification and the Kubota drawings

B. All in-tank MBR instruments and equipment less than 18 inches above the top of the tank shall be rated for Class 1 Division 2 per NFPA 820.

C. Refer to MBR Treatment Facility Upgrade drawings included in the bid documents. The MBR supplier will need to design their system based on this layout. Pump, blower, and large pipe locations cannot be moved. The existing tanks cannot be changed.

1.03 SUBMITTALS DURING CONSTRUCTION

A. Shop Drawings shall be submitted in detail sufficient to show MBR power and instrumentation wiring (if necessary). Shop Drawings shall be in color. Shop Drawings (submittals) shall include Process and Instrumentation Diagrams, dimensioned equipment layout drawings, and a list of all electrical power loads. Refer to Section 01 33 00, “Contractor Submittals,” regarding other submittal requirements.

B. Detail drawings and description of all items of equipment, showing all dimensions, operating conditions, parts, construction details, and materials of construction.

C. Biological Process Design: The MBR Supplier shall provide analysis and design of the biological process and the customer’s influent mass loading, diurnal flow curves, peak flow/loading numbers, and effluent limits.

D. Complete submittals for the instrumentation, including hardware submittals, test outline and procedure submittals, installation details, storage requirements, recommendations for spare parts and expendables, and documentation.

E. Complete control strategy description for the control and operation of the MBR system. This shall form the basis of the programming for the PLC control system.

F. Coordination: Where the installation of the equipment requires coordination with work to be performed by others, such coordination shall be clearly identified and indicated on the Shop Drawings.

G. Field and installation information, including mounting requirements. Equipment Assembly Plan and Instructions: Provide assembly plan and instructions for all equipment that will require some assembly by the installing Contractor at the job site. Said assembly plan and instructions shall be submitted to the Engineer during the Shop Drawing review period. Provide valve operator product information and wiring diagram.

H. Shop Drawings of electrical equipment shall include data sufficient for the Engineer to prepare load calculations, backup power calculations, and electrical service calculations for the facility. This includes the power consumption, voltage, phase, and motor starting arrangements. Drawings should also include detailed electrical wiring diagrams, showing component designation and rating, and the connection points, hazardous location electrical classification rating, and associated terminals and cable identification for connection to the power supply and process control system. Diagrams shall clearly differentiate factory wiring from field wiring, and shall indicate minimum wire sizes and type of conductors required for field wiring circuits.

I. The Engineer's review of and placement of Shop Drawings review stamp on any Shop Drawing is understood to be an acceptance of the character of the details and not a check of any dimensions or quantity and will not relieve the Supplier from responsibility for errors of any sort in Shop Drawings data or schedules, whether or not such errors are found by the Engineer in his review of such details.

J. A complete description of all interface links between the system components including:

   1. Number, size, and type of all process and auxiliary connections.

   2. Number, size, and type of electronic or electrical signal wires.

   3. Number, size, and type of electrical power wires.

   4. Control panel envelope dimensions, mounting requirements, and access requirements (doors, louvers, etc.).

K. Copies of the manufacturer's equipment guarantees.

L. Certification that all equipment provided includes all necessary permanent safety devices required by the State of Washington and Federal (OSHA) industrial authorities and applicable local and national codes.

M. Anticipated Equipment Delivery Schedule: An anticipated equipment delivery schedule shall be provided to the Owner and the Engineer during the Final Shop Drawings submittal period.

N. Operation and Maintenance Manuals: Operation and Maintenance Manuals shall be provided and submitted as specified in Section 01 78 23, "Operation and Maintenance Data."

O. As-Built Equipment Drawings: If changes are agreed to by the Supplier and Engineer after Shop Drawing review, the Supplier shall provide one set of as-built Shop Drawings prior to the Owner's payment for equipment manufacture and delivery. No changes shall be made from the "No Exceptions Taken" Shop Drawing after it has been reviewed except by the consent or direction of the Engineer in writing.

PART 2 – PRODUCTS

2.01 MBR EQUIPMENT AND CONTROL SYSTEM

A. The Kubota membrane system for the Tulalip Tribes' Wastewater Treatment Plant (WWTP) will be installed as part of the MBR Upgrade construction project. The membrane system will be installed at the existing wastewater treatment facility, which includes screens, grit removal, treatment tanks, UV disinfection, and subsurface effluent disposal. The plant does not include primary treatment facilities. The MBR system consists of two anoxic tanks, a pre-aeration tank, and four MBR tanks. The process shall be configured such that each MBR tank can be taken out of service for cleaning without effecting the operation of the other MBR tanks.

2.02 MBR PERFORMANCE REQUIREMENTS

A. The MBR system shall be designed to accommodate the flow as outlined in Table 46 11 30-1.

Table 46 11 30-1. Flow for Each MBR Tank

	Flow Conditions			
	AA	**MM**	**PH**	**PD**
Flow (MGD)	0.25	0.35	1.4	0.5

NOTES:
AA = Average Annual
MM = Maximum Month Average
PH = Peak Hour
PD = Peak Day

B. The membranes shall have the capacity to pass the peak day flow (and meet effluent criteria) for the duration of a typical maintenance and cleaning cycle (minimum of 4 hours) at the minimum wastewater temperature of 13 degrees Celsius. Supplier shall assume that equalization is **not** provided.

C. Process tanks are currently sized as shown in Table 46 11 30-2. The supplied equipment shall be designed to operate within this tank configuration.

Table 46 11 30-2. Process Tank Sizes

	Physical Conditions				
	Number of Tanks	**Max SWD (ft)**	**W (ft)**	**L (ft)**	**Total Vol. (ft^3)**
Pre-Aeration	1	12.5	43.5	14	7,613
Anoxic (new and exist)	2	22.5	21	21	19,845
MBR (new tanks)	2	22.5	29.58	14	18,635

Notes: Add two more identical tanks for buildout conditions

D. The MBR system shall also be designed to treat flows with the following additional characteristics:

1. Minimum Wastewater Temperature (7-day average): 13°C winter/maximum 22°C summer.

2. Site Elevation: 50 feet.

3. Influent Screening Size: 2 mm.

4. Influent Grit Removal: 95% (50 mesh) and 65% (100 mesh).

5. Effluent Monthly Average Goals: Wastewater effluent will be discharged to ground and therefore will be monitored based on preserving groundwater integrity. These effluent monthly average goals are based on MBR technological capabilities.

   a. BOD_5: 5 mg/L.

   b. TSS: 5 mg/L.

   c. Total Nitrogen: Less than 10 mg/L.

   d. Turbidity: 0.2 NTU.

   e. Total Coliform (with disinfection): 2.2/100 ml.

   f. The maximum hourly MBR effluent turbidity limit is 0.5 NTU.

E. MBR in-tank permeate and air piping and valves shall be designed and provided by the MBR manufacturer. Pipe supports and anchors shall also be provided. In-tank air pipe shall be stainless steel. Permeate valves and sample parts shall be provided for each module.

2.03 PROCESS MEASUREMENT DEVICES

A. Provide the following process measurement devices at the locations identified:

Location	Type
MBR Tank 1	Low Level Float
MBR Tank 2	Low Level Float
MBR Tank 1	Ultrasonic Level
MBR Tank 1	Thermal Mass Air Flow Meter
MBR Tank 1	Air Pressure Sensor
MBR Tank 3	Low Level Float
MBR Tank 4	Low Level Float
MBR Tank 4	Ultrasonic Level
MBR Tank 4	Thermal Mass Air Flow Meter
MBR Tank 4	Air Pressure Sensor
MBR 1 Permeate	Turbidity Meter x 2

Location	Type
MBR 1 Permeate	Electromagnetic Flow Meter
MBR 1 Permeate	Pressure Transmitter
MBR 2 Permeate	Pressure Transmitter
MBR 4 Permeate	Turbidity Meter x 2
MBR 4 Permeate	Electromagnetic Flow Meter
MBR 3 Permeate	Pressure Transmitter
MBR 4 Permeate	Pressure Transmitter

B. Provide each tank high and low level float switches with the following requirements:

1. Mechanical switch in polypropylene float casing, SPDT N.C., minimum of 10 A contacts rated for 120 Vac, CPE jacketed cable, UL recognized component, and the actuation point to be a maximum angle of 20 degrees above and 10 degrees below horizontal.

2. Provide mounting hardware and/or internal weighted bulb as required.

3. Acceptable Manufacturers: Gem Series MAnchor Scientific, intrinsically safe design with barrier, or equal.

C. Provide each turbidity meter consisting of a monitor and sampling unit with the following requirements: Shall be the same as the existing, ECD meters.

D. Provide ultrasonic level transmitters with the following requirements: Shall be the same as existing.

E. Provide electromagnetic flow meters with the following requirements: Shall be the same as existing.

F. Provide thermal mass gas flow meters with the following requirements: Shall be the same as the existing, FCI meters.

G. Programming of PLC and HMI will be done by the Owner:

1. General:

a. Provide a complete line-by-line description of all the programming necessary to operate the Kubota MBR as recommended by Kubota.

2. PLC Programming:

a. Provide a complete description of all the programming necessary to operate the Kubota MBR as recommended by Kubota.

2.04 VALVES

A. The following valves shall be provided with the MBR system:

1. Permeate pump flow control valves and operators (4 total).

2. Diffuser cleaning valves and operators for MBRs 1 and 4 (2 total).

3. 1-inch permeate sample valves (32 total).

4. 2-inch PA isolation valves (16 total).

5. 2-inch PERM-CLS 3-way ball isolation valves (32 total).

6. The PA and PERM isolation valves shall be the same as the existing valves.

B. Electric Operators:

1. Acceptable Manufacturers: EIM only.

2.05 STAINLESS STEEL PIPE AND FITTINGS

A. MBR Process Air Header and Drop Pipes: Stainless steel.

B. Pipe: Stainless steel, ASTM A778, Grade 304L, Schedule 10S, pickled and passivated. “As-welded” or “paper mill” grade meeting applicable portions of ASTM A778 acceptable. Butt welded joints with flanges at equipment and valves.

C. Fittings: Stainless steel, ASTM A774, Grade 304L, Schedule 10S. “As-welded” or “paper mill” grade. Butt welding type, flanged at equipment and valves.

2.06 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. In-Tank Process Liquid Piping – Low temperature air (less than 100 degrees F) and liquid.

1. Manufactured from PVC compound conforming to Type-1, Grade 1, ASTM D1784. Pipe shall conform to ASTM D1785.

2. Schedule 80 pipe shall be threaded or solvent welded. Written Engineer approval required for use of Schedule 40 pipe. Schedule 40 pipe shall be solvent welded.

3. Socket type fitting shall conform to ASTM D2467; threaded type fitting shall conform to ASTM D2464.

4. Solvent cement shall conform to ASTM D2564.

5. CPVC Pipe shall be Type VI grade 1 with cell classification 23447.

2.07 ADDITIONAL SPARE PARTS

A. The following additional spare parts shall be provided by the MBR equipment supplier.

1. One permeate pressure transmitter.

2. One tank/basin level transducer.

3. 600 cartridge membrane plates.

2.08 MBR WARRANTY

A. Where not specifically stated otherwise, all equipment supplied by the MBR equipment Supplier shall be warranted by the Contractor to the Owner as follows:

1. All work, including mechanical and electrical components of equipment, and/or packaged control systems which are furnished as components of the equipment specified hereinafter (except membrane fiber/plate), shall be guaranteed against defects in materials and workmanship for a period of 1 year following acceptance of the installed equipment by the Owner (substantial completion under the General Contractors contract). Supplier shall warranty all actuated valves with an expected number of duty actuations exceeding two actuations/minute for a minimum period of 3 years. The warranty shall not be prorated.

2. All equipment shall be guaranteed as merchantable and suitable for the purpose intended and will provide the results required by the Contract Documents.

3. The Contractor shall make, at his own expense, all repairs and/or replacements necessitated by defects in materials or workmanship supplied by him that become evident within the warranty period.

B. The membrane filter cassettes/modules, including material, shall be warranted for 5 years. Manufacturer shall provide material if membranes require replacement within 5 years of start-up.

PART 3 – EXECUTION

3.01 OPERATION AND MAINTENANCE MANUALS

A. Operations and Maintenance Manuals with equipment installation instructions shall be provided in accordance with Section 01 78 23, “Operation and Maintenance Data.”

3.02 FIELD SERVICES DURING INSTALLATION, TESTING, AND START-UP

A. The MBR supplier shall provide the services of factory trained representatives to provide field services in accordance with Section 01 12 00, “Installation, Testing, and Commissioning for MBR Equipment”. Unless otherwise specified, the Supplier shall provide as a minimum the following on-site field services:

   1. Installation observation and Certification: Six (6) working days on site, excluding travel time.

   2. Testing and Start-Up: Fourteen (14) working days on site, excluding travel time.

   3. Training: Two (2) working days on site broken into two 3-hour sessions, excluding travel time.

B. Training of the Owner’s personnel shall include a detailed discussion of process operation and control theory. An outline of the proposed training and the resume of the manufacturer’s representative proposed to provide the training shall be submitted for review and approval by the Engineer.

END OF SECTION

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SECTION 46 20 70

ROTATING DRUM SCREEN WITH INTEGRATED SCREENINGS WASHING

PART 1 – GENERAL

1.01 DESCRIPTION

A. Screen shall be required to provide a thorough spray screenings washing and compacting system with solenoid valve(s), suitable for Class 1 Div. 2 area installation, to provide a relatively dry screenings, clean of fecal material. All flow to the plant is pumped. Screenings shall contain less than 5 percent by weight fecal material or additions/modifications to screen spray shall be provided and installed, at no additional cost to the Owner, until results meet requirements. A screenings bagging discharge unit shall be provided for each screen, so that all screenings are in sealable, disposable bags.

B. Contractor shall furnish, install, and place into satisfactory operating condition one (1) rotating perforated drum screen for removing floating, particulate and fibrous material and for conveying, washing, dewatering and compacting the screenings before discharging the material into bags; as shown on the drawings and described in the specifications.

C. It is the intent of these specifications that all equipment called for under this section shall be supplied by a single manufacturer.

D. Unit shall be provided with freeze protection package for outdoor screen installation.

E. Screen to be installed in a 36-inch-wide channel. Contractor to coordinate with manufacturer how to add stainless steel equipment to channel to fit screen width and to make channel walls a screen absolutely vertical.

F. Screen shall be provided with 3-year maintenance agreement. Manufacturer representative shall perform the Huber recommended 1-year maintenance to screen unit on-site.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM) Publications:

1. Section A322: Carbon and Alloy Steel Bar Specifications.

2. Section A507-10: Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled.

B. Anti-Friction Bearing Manufacturers Association (AFBMA) Publications:

1. Standard 9-90 Load Ratings and Fatigue Life for Ball Bearings.

2. Standard 11-90 Load Ratings and Fatigue Life for Roller Bearings.

C. American Institute of Steel Construction (AISC) Publications.

D. American Welding Society (AWS) Publications.

E. American Structures Painting Council (ASPC) Publications.

1.03 SUBMITTALS

A. The following information shall be submitted to the Engineer. In accordance with Section 01 33 00, “Contractor Submittals”, copies of all materials required to establish compliance with this Section. Submittals shall include the following:

1. Product Data: Include the following:

    a. Descriptive literature, brochures, catalogs, cut-sheets and other detailed descriptive material of the equipment.

    b. Motor characteristics and performance information.

    c. Motor nameplate data.

    d. Gear reducer data including service factor, efficiency, torque rating, and materials.

    e. Parts list including a list of recommended spare parts.

2. Shop Drawings: Include the following:

    a. Manufacturer’s installation drawings.

    b. Control panel wiring and schematic diagrams.

3. Operations and Maintenance Manual: See Section 01 78 23, “Operation and Maintenance Data”.

4. Detailed installation instructions, with clear step-by-step points on the correct mechanical and electrical installation procedures.

5. Equipment weights and lifting points.

6. Recommendations for short and long term storage.

7. A copy of the manufacturer’s warranty

8. A copy of documents proving certification of the Manufacturer’s Quality Management System according to ISO 9001 and Environmental Protection Management System according to ISO 14001.

9. Failure to include all drawings applicable to the equipment specified in this section will result in rejection of the entire submittal with no further review.

10. Heat load calculations for screen local control panel.

1.04 QUALITY ASSURANCE

A. To ensure quality, conformance, and reliability with regard to the manufacturing and production of the equipment, the manufacturer shall meet all requirements listed hereafter:

1. Manufacturer shall have a minimum of twenty (20) years of experience producing equipment substantially similar to that required and shall be able to submit documentation of at least fifteen (15) independent installations using the same size or larger equipment as detailed in the below. Each installation must have been in satisfactory operation for at least five (5) years.

2. The Contract Documents represent the minimum acceptable standards for the screening equipment for this project. All equipment shall conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications. All manufacturers shall modify, redesign, and furnish with special features or accessories, use materials or provide equipment with finishes as may be necessary to conform to the quality mandated by the technical and performance requirements of this specification.

3. The entire unit shall be manufactured from AISI 304L stainless steel shapes. All components made of stainless steel shall be passivated by full submergence in a pickling bath for perfect surface finishing. No stainless steel components may be fabricated or assembled in a factory where carbon steel products are also fabricated, in order to prevent contamination by foreign debris which can cause corrosion of stainless steel.

4. Electric motors, gear reducers, and other self-contained or enclosed components shall have an acrylic enamel finish.

5. All stainless steel parts of the unit shall be fully submerged into a pickling bath for at least 8 hours to remove welding spots and to protect the stainless steel against corrosion. Glass bead blast or chemically treated stainless steel shall not be allowed.

6. Fabrication shall be done in compliance with all applicable ASTM standards or equivalent international standards.

7. All welding in the factory shall use shielded arc, inert gas, MIG or TIG method. Filler wire shall be added to all welds to provide for a cross section equal to or greater than the parent metal. Butt welds shall fully penetrate to the interior surface and gas shielding to interior and exterior of the joint shall be provided. All welding is performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code, or equivalent.

8. Bolts, nuts, and washers shall be selected from AISI 304L or 316L stainless steel such that they are anti-seizing.

9. Manufacturer shall have established an ISO 9001 certified quality management system. Equipment suppliers not utilizing ISO 9001 facilities shall not be considered or approved for this project. Equipment supplier shall provide evidence of certification before being named as an acceptable manufacturer.

10. Manufacturer shall provide screen, wash press, motors, gear reducers, controls, control panels, and lifting attachments as a complete integrated package to ensure proper coordination, compatibility, and operation of the system. The manufacturer shall test-run the fully assembled machine in his factory before shipment.

11. Manufacturer shall provide services by a factory-trained Service Engineer, specifically trained on the type of equipment specified. Prior to equipment start-up the Service Engineer shall certify that the screen has been installed per the manufacturer's requirements.

1.05 EQUIPMENT GUARANTEE

A. In-channel fine screen shall guarantee all materials and equipment for a period of 2 years (24 months) following system acceptance and shall replace all failed or defective parts and equipment, including cost for installation labor and shipping to the jobsite.

B. Refer to yearly maintenance required by Huber representative for first 3 years of operation in Section 1.01 F.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Base Bid: Rotamat Perforated Plate Screen RPPS STAR/780/2 from Huber Technology, Inc. See "Schedule of Major Equipment Items" at the end of the "Contract Legal Documents".

B. Other pre-submitted and pre-approved Deductive Alternates.

C. Equipment of all manufacturers must be in accordance with these specifications and plans. Being named as a manufacturer does not eliminate their responsibility of providing equipment in compliance with the following specification section. Any deviations without sufficient evidence proving equal or superior quality shall be rejected without further review or comment.

2.02 PERFORMANCE REQUIREMENTS

A. Screen Design Summary:

1. Number of screens:	1
2. Nominal screen basket diameter:	30.71 inches (780 mm)
3. Maximum wastewater flow at 250 mg/l TSS, mgd:	1.56 mgd
4. Head loss at maximum capacity:	8.88 inches
5. Maximum upstream water level, inches:	21.4 (675 mm)
6. Maximum wet screenings capacity, cfph:	80.5

7. Channel width, inch: 36 inches

8. Channel depth, inch: see Drawings

9. Discharge height from top of channel, inch: see Drawings

10. Screen opening size, inches: 2 mm

11. Location rating: Class 1, Division 2

B. The fine screen shall be designed to operate at 1.5 mgd while 50 percent blinded and have a maximum head loss of 1.3 feet.

C. The nominal bar spacing specified above shall be the size of the circular openings. Screen designs which define the bar spacing as the distance between a fixed bar element and a moving adjacent bar element are not acceptable. Screen using rotating rakes, screw flight mounted brushes, perforated plate, or traveling filter media are also not acceptable.

D. The average bar screen flow through velocity shall not exceed 3.3 feet/sec (1.0 m/sec) under any flow condition up to the maximum clean water flow specified above. The screen design shall minimize solids deposits in the channel.

E. The screen shall be capable of processing spherical objects with a diameter of up to 3-1/8 inches. Such objects shall be conveyed through the auger and shall be discharged with the screenings. The unit shall be capable of processing the screenings load specified above.

F. The perforated plate screen shall consist of a rotating cylindrical screen with an integral screw conveyor and screenings press. The fine screen shall use a single drive for screening, conveying, dewatering and compressing the screening material. The screen shall have an inclination of 35 degrees.

G. Operation of the rotating screen shall be automatically initiated at a preset high upstream liquid level. Screens which operate continuously or via timer only will not be acceptable. The rotating basket shall remove solids from the flow and deposit them into the concentric screw conveyor hopper using a spray bar and basket cleaning brush providing positive cleaning of the screen basket surface. The screenings shall be transported up the screw conveyor, through an integrated screening washing system, a compaction and dewatering zone and then shall be discharged into heavy duty screenings bags.

H. All open spaces of the screen shall be positively cleaned via a spray bar and cleaning brush system. Screen using a rotating rake or only screw flights with brushes will not be acceptable.

I. The screening equipment shall produce dewatered screenings capable of passing the EPA Paint Filter Test as described in method 9095 of EPA Publication SW 486.

J. To minimize odors and nuisance, the conveyance, dewatering and compaction zones shall be completely enclosed.

K. The spray wash system shall be enclosed such that spray water, aerosols or leakage do not contaminate the operating floor.

L. The control system shall be designed such that the cleaning characteristics of the screen and wash system can be changed via the programmable controller. Systems which do not offer this feature will not be acceptable for this project.

M. Materials:

1. Unless otherwise specified in these specifications, the entire equipment shall be manufactured from AISI 304L austenitic stainless steel shapes (rods, angles, and channels), pipes, and sheets. All mechanical parts shall be designed to handle the forces that may be exerted on the unit during fabrication, shipping, erection, and proper operation according to the O&M manual.

2. The entire equipment shall be manufactured in a stainless steel only factory to prevent contamination of the stainless steel with foreign contaminants.

3. The equipment, after its fabrication, shall undergo a passivation (pickling) process to ensure maximum resistance to corrosion. All stainless steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel. Submergence insures complete coverage. Spray on chemical treatments and glass bead blasting are specifically not acceptable due to their inability to provide complete and uniform corrosion protection.

2.03 PRODUCT DESIGN SPECIFICATIONS

A. Screen:

1. The cylindrical fine screen shall be designed and built to withstand all static and hydraulic forces exerted by the liquid to the screen. All structural and functional parts shall be sized for the loads encountered during screening, conveying and pressing operations.

2. The perforated plate screen shall be designed and built to withstand static and hydraulic forces exerted by the liquid to the screen. All structural and functional parts shall be sized for the loads encountered during the screening, conveying, and pressing operations. All submerged components and all components of the rotary screen in contact with the screened solids shall be of stainless steel construction.

3. The screen basket shall be of a cylindrical shape. The perforated plate shall be around the entire basket circumference. The perforated plate openings shall be as specified in 2.02.A. Bars or wedge wire will not be acceptable screen media.

4. The basket diameter shall have a width as noted in 2.02.A and be provided with a sufficient clear opening area to ensure the maximum flow rate of 3.3 fps is not exceeded at the maximum flow as specified in 2.02.A.

5. The upper end of the basket shall incorporate a support ring which shall be machined and supported by three (3) guide rollers made of polyamide. The guide rollers shall be attached to an upper support plate. This plate shall match a flange that is attached to the augur tube to ensure proper alignment of the basket. A brush shall be clamped to the upper support plate sealing the gap between the rotating screen basket and the fixed upper support plate.

6. The lower support ring of the basket shall be connected to the shaft of the auger and be driven by a common drive with the auger. The basket shall be connected with a solid support arm at the lower end of the basket which is bolted to the auger shaft.

7. A seal plate shall be provided between the circular screen and the channel. The seal plate shall be one-piece fabricated of stainless steel plate. The sealing plate shall be of sufficient height to prevent bypassing of flow around the screen at the maximum screen hydraulic capacity. A polyurethane seal shall be provided to ensure proper sealing of the rotating screen basket against the fixed sealing plate. This polyurethane seal ensures that there will be no bypass of unwanted solids through the screen. Screen using a brush for sealing the gap between the fixed seal plate and the rotating screen basket shall not be allowed.

8. The screen shall be provided with a support stand. The support stand shall be fabricated from stainless steel Double-C-Channels having the minimum dimensions of 7 inches by 2.75 inches with a thickness of 0.125 inches.

9. Screen housing not required.

B. Cleaning Brushes:

1. The screen basket shall rotate in one direction and pass through the topmost position where it is cleaned with a stainless steel high pressure spray bar and a stainless steel backed nylon brush with bristles that penetrate the depth of the perforated plate screen to ensure positive screenings removal. Brush bristles shall be high-strength nylon for superior life.

2. The brush shall be designed to ensure cleaning of the spaces to the full depth of the perforated plate. The cleaning brush shall be mounted upon a stainless steel holding device which keeps the brush in constant contact with the basket and will automatically adjust to allow for brush wear.

3. Another stainless steel backed nylon brush shall be attached to the rotating basket and positioned to make contact with the screening trough to sweep material caught on the edges of the trough.

C. Screenings Conveyor and Screenings Wash-Press:

1. The auger tube shall have a diameter of 10.75 inches. The auger tube shall incorporate two (2) anti-rotation bars which shall be welded to the inside of the transport tube along the longitudinal axis. The screw shall not be in contact with the anti-rotation bars during normal operation, the screw shaft shall be supported by a Teflon® lined bronze slide bearing at the bottom and the gear box at the top.

2. A support flange with a minimum thickness of 0.6 inches shall be welded to the screenings transport tube. The screen basket rollers and the screenings collection hopper shall be attached to this plate.

3. A gear box support flange with a minimum thickness of 0.467 inches shall be welded to the upper end of the screenings transport tube for attachment of the drive assembly.

4. A shafted auger screw that is entirely made of stainless steel shall be provided to transport and dewater the screened material. A shaft-less screw shall not be acceptable. Screw flights shall be of decreasing pitch approaching the compaction zone to provide a mechanical compressing action on the screenings material. The shaft shall have a diameter of 3.5 inches and shall have flights with a minimum thickness of 0.2 inches in the transport zone and 0.4 inches in the compaction zone. A replaceable flight section with an angle of about 120 degrees that is bolted to the shaft shall be provided at the bottom of the shaft where the wear is highest.

5. A compaction zone shall be an integral part of the screenings screw conveyor and transport tube design. The compaction zone shall be designed to form a screenings plug of material and to return water released from the screened material back to the wastewater channel/pump sump through circular holes that are machined into the screenings transport tube.

6. The auger shaft shall be fitted with an upper and a lower solid stub. Stubs and screw shaft shall be accurately machined and shrink-fitted.

7. The lower end of the screenings conveyor shall be supported by a sealed, self-lubricated, Teflon® lined bronze slide bearing. This bearing shall not take any thrust load from the screw conveyor. Lower ball or roller bearings, or bearings requiring lubrication, shall not be acceptable.

8. The lower bearing shaft and arm shall be designed to minimize material wrapping around the shaft. A seal plate shall be furnished to mate between the stationary lower bearing support and the rotating arm to prevent material intrusion into the bearing seals.

9. A compaction zone shall be provided as an integral part of the screw conveyor and tube. The compaction zone shall be designed to form a plug of screenings material and to return water released from the screened material back to the channel through 0.24-inch (5 mm) diameter perforations that are machined into the screenings transport tube in a square configuration.

10. The compaction zone shall be provided with split glass fiber reinforced housing, furnished with gaskets and bolts, and easily removable for access. Designs requiring removal of the drive assembly, discharge head, or screw conveyor to gain access to the compaction zone will not be acceptable. The housing shall be provided with a drain connection at its lowest point and a clamped flexible PVC hose for drain water whose other end is connected to a connection through the screen basket's upper support flange to return the drain water into the screen basket. The plastic housing shall also be provided with a 1-inch flush connection.

D. Drive:

1. The basket mechanism and transport screw shall be driven by a shaft mounted geared motor. The geared motor shall have a minimum service factor of 1.0. The motor shall be provided with thermostats to provide thermal overload protection in addition to current overload protection.

2. The gear reducer shall be bolted to a machined flange welded to the upper end of the transport tube.

3. The gear reducer shall be driven by a 3-phase, 60 Hertz, 460 Vac, Class 1, Division 2, Group D continuous-duty, totally-enclosed, fan-cooled motor which leads to conduit box for outdoor installation. The motor rating shall be a minimum of 2.0 hp.

E. Spray Wash Systems:

1. The screen shall be designed for a water supply of 33 gpm and shall be provided with wash water distribution manifold with a single 1.5-inch point for connecting to the treatment plants final effluent water supply.

2. An automatic spray wash system shall be provided for cleaning of the screen basket and shall be constructed of minimum 1-inch-diameter piping and minimum 1-inch-diameter flexible reinforced PVC hose. The spray wash systems shall be operated only while the screen basket is rotating. The spray wash system shall include a single 1-inch SST solenoid valve for flow control.

3. The screen shall incorporate a screenings washing system (IRGA) consisting of two washing points, one being in the rising tube of the screen and the second being in the screenings collection hopper. The screenings wash zone in the conveyor tube shall be provided with three nozzles located equidistant around the circumference to maximize the washing performance. A lower wash system shall be located above the open top of the hopper and shall utilize a spray bar with a minimum of 6 spray nozzles. The screenings washing system shall include a single 1 inch solenoid valve for flow control.

4. The screen compaction zone shall be provided with a wash nozzle designed to flush the entire interior surface of compaction zone housing to ensure no debris buildup can occur. The compaction zone flushing system shall include a single 1-inch solenoid valve for flow control.

5. The solenoid valves shall be operated by the screen local control panel. Individual manual operation of each solenoid shall also be possible from the control panel.

6. The solenoid valves shall be minimum 1-inch diameter, stainless steel body, 2 way, and designed for 120 VAC with an explosion proof (Class I, Division 2, Group D) rating. Solenoid valves shall be normally closed and rated for up to 100 psig.

7. A stainless steel or PVC body Y strainer shall be provided for the incoming plant water supply.

F. Bagger:

1. The discharge chute shall be furnished with a bagging device to contain and encase dewatered screenings. The bagging device shall use endless bags.

2. The bagging device shall be fabricated of minimum 12-gage (2.5 mm) stainless steel.

3. The screenings bagger shall be designed to be fitted with 295-foot endless replaceable plastic bags.

G. Anchor Bolts:

1. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Anchor bolts, hex nuts, and washers shall be stainless steel. Anchor bolts shall be wedge or epoxy type.

2. Anchor bolts shall be set by the contractor. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

H. Screen Control System Panel:

1. Provide controls necessary for full automatic operation of the screen.

2. Provide loop powered ultrasonic level sensor and transmitter for automatic control of the screen via liquid level.

3. In compliance with Division 26 and Division 40 specifications.

4. Screen local control panel (LCP-1606) shall be suitable for outdoor use in a wet and corrosive environment. The Headworks screening area is a Class 1, Division 2, Group D hazardous area per NPFA 820. The enclosure shall be free standing, NEMA 8 stainless steel with lockable door latch and shall include the following:

a. Provide power distribution and transformation within control panel to supply power to entire screen system (controls, motors, solenoids, instruments, etc.).

b. Door-interlocked and fused disconnect.

c. 600 Vac terminal block to accept a single 3-phase, 480 Vac, 60 Hz feed.

d. VFD and MCP type circuit breaker for screen motor.

e. Control power transformer with 120 Vac Surge Protective Device (SPD) and fused primary and secondary.

f. Programmable logic controller (PLC), Allen Bradley CompactLogix.

g. Operator Interface (OIU), C-More HMI Touch Panel.

h. LED, Push-to-Test, 30 mm, pilot lights for:

1) “Control Power On” (white).

2) “Screen Running” (green).

3) “Screen High Level” (amber).

4) “Screen Fault” (red).

i. 30 mm, maintained, selector switch for the following:

1) Screen drive “Hand-Off-Auto”.

2) Screen drive “Forward-Off-Reverse”.

j. Spray wash momentary push buttons:

1) Spray bar.

2) Screenings washing system (IRGA).

3) Compaction zone flushing.

k. E-stop push button (red).

l. “Screen Reset” momentary, 30 mm, push button (black).

m. Door-mounted elapsed time meters (accuracy to 1/10 hour) for the following:

1) “Screen Drive”.

n. Provide discrete inputs for remote control from PLC/SCADA as follows:

1) Screen Run/Stop.

2) Screen Maximum High Level.

3) One spare status contact.

o. Provide remote dry contact outputs for connection to PLC/SCADA as follows:

1) Screen Running.

2) HOA in AUTO contact.

3) Screen Faulted.

4) Screen Stopped.

5) Screen High Level Alarm.

6) Emergency stop.

7) Two spare output contacts.

p. Flashing LED alarm beacon and alarm horn with silencer-reset button.

q. 120 VAC panel heater with thermostat.

r. Nameplates: Engraved, phenolic, white lettering, black background.

s. Intrinsic barriers and relays: Provide as needed to address Classified Areas.

t. VFD shall be as specified in Section 26 29 23, “Variable Frequency Motor Controllers.”

I. Outdoor Weather Protection:

1. The screenings transport tube shall be furnished with thermal insulation of mineral wool, riveted stainless steel protective covers and a heat tracing system for outdoor weather protection which shall enclose the screenings transport tube; compaction and dewatering zone; and all spray wash piping, ball valves, and solenoid valves.

2. The outdoor weather protection system shall include (Class I, Division 2, Group D) self-regulating heat tracing, adjustable thermostat, insulation, and a stainless steel protective jacket.

3. The heat tracing system shall be suitable for operation down to a minimum temperature of -23 degrees C (-10 degrees F) and shall be powered from the main control panel. Auger and water lines to also be heat traced.

4. Where the wash water supply and electrical wiring conduit penetrates the stainless steel cover bulkhead, adapters shall be provided. Easy access shall be provided to every component requiring service or maintenance.

2.04 SPARE PARTS

A. The following spare parts shall be included and supplied together with the equipment:

1. One complete bottom bearing assembly.

2. Two sets of basket cleaning brushes.

3. Three solenoid valve rebuild kits.

4. Five boxes with 295-inch endless bags each.

5. Three plastic rollers.

6. Two complete solenoid valves.

PART 3 – INSTALLATION

3.01 FIELD PREPARATION AND PAINTING

A. Contractor shall touch up all shipping damage to the paint and stainless steel as soon as the equipment arrives on the jobsite.

B. Contractor shall coat all stainless steel bolts and nut threads with a non-seizing compound prior to final assembly.

3.02 INSTALLATION, START-UP, AND OPERATOR TRAINING

A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of significant deviations.

B. Installation of the equipment shall be in strict accordance with the contract documents and the manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractors shall install the anchor bolts in accordance with the manufacturer's recommendations

C. Manufacturer shall furnish the services of a factory-trained Service Engineer for two (2) trips including three (3) 8-hour days to inspect the installation, and carry-out the equipment start-up procedures. The representative shall provide at least 4 hours of training to the operators in how to effectively operate and maintain the equipment.

1. Equipment shall not be energized, or "bumped" to check the electrical connection for motor rotation without the Service Engineer present.

2. The Service Engineer shall make all necessary adjustments and settings to the controls. In particular, the Service Engineer shall verify the measurement relay setting and the initial water level setting for the screen.

3. The Service Engineer shall demonstrate proper operation of screen and screenings washer, heat trace system, and control panel heater and thermostat. The screen shall operate automatically based on the water level.

END OF SECTION

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SECTION 46 50 50
MBR AIR BLOWERS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies the positive displacement blowers used to aerate the MBR Tanks. The DuroFlow 7018, as manufactured by Gardner Denver, will be the only acceptable blower.

2. Furnish blower complete with intake filter, intake and discharge silencers, pressure relief valve, double check valve, discharge pressure gauge, air temperature shutdown switch, motor, coupling, base plate, and all appurtenances specified. All piping required between the blower and the discharge outlet shall be provided. Complete unit shall be assembled at the manufacturer's factory so that testing of operation and noise levels can be conducted and then disassembled for shipment to the jobsite. Acoustic enclosure shall be included if necessary to meet specified noise limitations.

1.02 REFERENCES

A. American National Standards Institute (ANSI) B16.1, B40.1.

B. American Society of Mechanical Engineers (ASME) PTC 9.

C. American Gear Manufacturers Association (AGMA).

D. American Society of Testing and Materials (ASTM).

E. Anti-Friction Bearing Manufacturers' Association (AFBMA) 9, 11.

F. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).

G. Institute of Electrical and Electronics Engineers (IEEE).

H. Mechanical Power Transmission Association.

I. National Electrical Code (NEC).

J. National Electrical Manufacturers Association (NEMA) MG 1, ICS 6.

K. National Fire Protection Association (NFPA) 70.

L. Occupational Safety and Health Administration (OSHA).

M. Rubber Manufacturers Association (RMA).

N. Steel Structures Painting Council (SSPC).

O. Underwriters Laboratories (UL).

1.03 QUALITY ASSURANCE

A. Factory Testing: The supplier shall provide open field noise test information on the complete blower assembly and submit certified noise test curves prior to shipment. The noise level shall be measured at four separate locations around the blower at 3 feet and four locations at 10 feet. The low frequency portion of noise measured at 10 feet (that cannot accurately be measured at 3 feet) shall be adjusted and added to the noise measurements taken at 3 feet. The Owner reserves the right to witness this test at the Owner's expense.

B. All equipment and devices are listed by, and shall bear the label of, Underwriters Laboratories (U.L.), CSA-C/US label, or label accepted by Washington State Department of Labor and Industries.

1.04 SUBMITTALS

A. The following submittals shall be made in accordance with Section 01 33 00, "Contractor Submittals".

1. Motor data submittal information:

   a. Completed Motor Data Form. Certify that feeder cable length will not require a filter to protect motor for VFD operation.

   b. Guaranteed minimum efficiency at rated load at rated voltage.

   c. Starting current at rated voltage.

   d. Guaranteed minimum power factor at rated load at rated voltage.

   e. Expected efficiency at 1/2, 3/4, and full load at rated voltage.

   f. Expected power factor at 1/2, 3/4, and full load at rated voltage.

   g. Motor no-load current at rated voltage. Full-load current at rated voltage. Full-load current at 110 percent voltage.

   h. Full-load speed.

   i. Motor nameplate data.

   j. Certified copy of test report for identical motor tested in accordance with NEMA MG 1 and IEEE Standard 112, Test Method B.

2. Drawings showing plan, elevation, and appropriate cross sections, sound enclosures, general dimensions and confirming blower's piping connections, construction details, wiring diagrams and weight of major components.

3. Parts list noting materials of construction.

4. Certified performance curves confirming rated capacity, pressure, horsepower, speed, and efficiency. Data shall include predicted temperature increase and tip speed at each specified operating condition. Range of recommended operation must be shown on capacity curve.

5. Certification of bearing life.

6. Certified results of factory noise measurement tests.

7. Manufacturer's descriptive literature for intake filter and inlet and discharge silencers, including dimensional drawings, materials of construction and weights. Include noise attenuation data for silencers and particle removal efficiency data for filter.

8. Data sheets and product manuals for all instrumentation. Complete description of all controls and control panel, including complete master wiring diagrams, elementary or control schematics, and panel outline drawings.

9. Vibration isolation system.

10. L10 bearing life calculations for each motor bearing.

11. A list of all exceptions and an explanation of each non-compliance with the specifications.

12. Confirmation letter from the motor manufacturer confirming the submitted motor is compatible with the submitted VFD.

1.05 SYSTEM RESPONSIBILITY

A. The Supplier shall assign unit responsibility for the complete blower package, including blower, silencers, filter, pressure relief valve, motor, and other appurtenances to the blower manufacturer. This provision, however, shall not be construed to relieve the Supplier or other suppliers of responsibility for their portion of the work and warranties.

1.06 SPARE PARTS

A. The following spare parts shall be provided:

1. One set of any special tools required to service the blower.

2. Spare filter elements.

3. Two complete sets of belts.

1.07 STORAGE AND HANDLING

A. Care must be taken during unloading and handling of equipment to ensure against undue strain to the compressor and motor. DO NOT use lifting straps or chains under the compressor or motor. Lift from under the main frame, base or use base mounted lifting lugs (if provided).

B. In storage blowers must be kept clean, free of moisture and rotated a minimum of 20 revolutions each week to maintain warranty. For storage in excess of four months, or in a damp or corrosive environment see the manufacturer's operation and maintenance manual.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Positive displacement blowers shall be the high efficiency type DuroFlow 7018, as manufactured by Gardner Denver and packaged by Universal Blower Pac, or approved equal. See Schedule of Major Equipment in the Legal Documents portion of the contract documents. Motors shall be high efficiency as tested per IEEE Procedure 112A, Method B. Blowers shall be provided with acoustic enclosures.

B. The blower inlet silencer shall be RIS series silencer, and the blower discharge silencer shall be RD series silencer, both as manufactured by Universal Silencer, or equals.

C. To provide adequate access to the blower, the blower with sound enclosure maximum dimensions shall be 55 inches by 105 inches by 95 inches.

2.02 CONDITIONS OF SERVICE

A.	Application:	Mixing
B.	Number of Blowers:	2
C.	Site Elevation, MSL Datum:	50
D.	Maximum Inlet Temperature, degrees F:	90
E.	Maximum Relative Humidity, percent:	85
F.	Scfm ± 4 percent:	550 – 1,700
G.	Icfm ± 4 percent:	625 – 1,920
H.	Differential Pressure, Psig:	8.8 – 10.3
I.	Max Bhp Required:	121
J.	Rpm Limit At Above Scfm:	2,279
K.	Motor Size, Hp:	125

L. Blowers shall be capable of variable speed operation with a minimum turndown of 30 percent air flow (SCFM). Blower maximum RPM to be 2,650.

M. The blower shall be capable of withstanding adequate additional pressure above the maximum specified so as to evacuate the airlines and diffusers during start-up.

N. The blower noise shall not exceed 80 dBA at 3 feet per ISO Standard test methods. A sound attenuating enclosure shall be provided if necessary to meet the noise limitations. The supplier shall perform open field noise test of data showing compliance with the above condition.

O. Contractor is responsible for providing power to any additional equipment required for the blowers (e.g., enclosure fans), if required.

2.03 CONSTRUCTION

A. Compressor:

1. Impellers: bi-lobe design; ductile iron; static and dynamically balanced; operate without rubbing, liquid seals or lubrication.

2. Shafts: Cast integrally with the impellers.

3. Timing Gears: Helical tooth; alloy steel; held by taper pins, wedge rings, or bolted to timing hubs spline mounted to the shafts.

4. Lubrication: Oil splash.

5. Seals: Labyrinth.

6. Attenuation:

a. It is the intention of this section of the contract documents to procure an acoustical enclosure for the specified blower system. The Enclosures shall be designed, assembled and inspected by Universal Blower Pac, Inc. at the manufacturing site with documentation provided to verify the noise reduction demanded in these documents. Noise attenuation shall be provided as necessary to reach the specified sound limit requirement at a distance of 1 meter from the operating equipment in a free field environment. All readings shall be taken by personnel experienced in the field of sound attenuation.

b. The enclosure herein specified shall be designed and manufactured by the blower system manufacturer specifically for the equipment supplied. Units shall be designed to be picked up by a fork truck. Each acoustical enclosure shall be shipped completely assembled. Each enclosure shall ship installed on the blower system when feasible. No field assembly shall be permitted

c. Absorption of sound waves shall be the basis of design for the enclosure. Where feasible, only the compressor shall be enclosed to meet the demanded sound level. Where necessary, the complete blower system will be enclosed to meet the level specified. With absorption considered, perforated metal inner skin retaining devices shall not be considered acceptable.

d. Outer skin shall be a minimum 14-gauge Galvanized Steel. Lesser gauges shall not be acceptable.

e. Absorption media shall be a nominal 2-inch thick resilient material capable of returning to its original form after compression. Media shall have an overall weight of not less than 1.6 pounds per cubic foot. Media sheets shall have an upper oil resistant layer a minimum of three millimeters in thickness to protect the integrity of the media. Absorption media shall be interior and be fitted to each exterior facet and show contact at all points. Media shall be snug fit, be complete with pressure sensitive adhesive and held in place with washers, studs and cap nuts manufactured from corrosive resistant materials. All adhesives used in anchoring studs or other items in structure shall be high temperature industrial material rated for the application. Any acoustical material used shall conform to the following:

1)	Color:	Charcoal Grey
2)	Density:	1.6 lbs/ft^3 (24.03 kg/m3) per ASTM D3574-86 test A
3)	Tear Strength:	2.0 ppi (3.5 N/cm) per ASTM 3574-86 test F
4)	Tensile Strength:	20 psi (135 kPa) per ASTM 3574-86 test E
5)	Elongation:	110 percent per ASTM D3574-86 test E
6)	Compression:	Max. 10 percent ASTM D3574-86 test D
7)	Heat Resistance:	Per ASTM D3574-86 test K
8)	Humidity:	Per ASTM D3574-86 test J
9)	Flammability:	MVSS 302 UL-94 HBF and SAES – 369(b)
10)	Service Temperature:	–40 degrees F to +212 degrees F cont. (250 int)
11)	Thermal Conductivity:	BTU-in/ft^2h degrees F 0.25 per ASTM C 177

f. Any access plates installed on enclosure for venting or screening shall be installed with self-starting, self-locking zinc plated screws to promote tightness. Rivets or loose fitting panels which can loosen during operation will not be accepted. Slide-in panels showing a loose fit shall provide grounds for rejection. Panels shall be constructed as to compress media on installation providing tightness and maximum sound absorption.

g. Each enclosure will have service doors, covering at least 80 percent of each side. Hinges for the doors shall be full length and designed for the weight of the door provided. Door shall have a minimum 180-degree swing. All surfaces and edges shall be free of burs and sharp edges. The doors shall lock.

h. Each enclosure will be fitted with a weather hood covered acoustical intake vent rated for the SCFM listed in the “service” section and discharge pipe openings with sound seal.

i. Oil fills and drain extensions, and weather/sound seals will be fitted on all enclosure penetrations as needed

j. A cooling fan with acoustical vent shall be supplied installed on the enclosure. To ensure adequate cooling at all speeds the cooling fan will not be connected to the compressor or motor shaft in any way.

B. Motor:

1. Motors shall be high efficiency as tested per IEEE Procedure 112A Method B.

2. HP: Nameplate greater than the brake horsepower at 10 percent above the relief valve set pressure.

3. RPM: 1800.

4. Type: TEFC.

5. Power: 460 volt, 3 phase, 60 Hertz.

6. Insulation: Class H with rise 180 degrees (356 Degrees F).

7. Service Factor: 1.15 (or 1.0 if used in conjunction with VFD) at power voltage and site elevation listed above.

8. Efficiency: “premium efficient” per latest edition of NEMA MG1.

9. The motor will be designed, constructed, warranted for 2-year operation by a constant-torque variable frequency drive for 10:1 turn down. The insulation shall meet or exceed the current NEMA MG1-31.4.4.2 and have a Class H thermostat in each phase. Motor and variable frequency drive must be capable of starting, accelerating, and maintaining blower operating speed within the specified operating range on a continuous basis without overheating.

10. Certification that motor feeder cable length does not require filter for motor protection.

11. Stator Temperature Monitoring: Snap-Action, bi-metallic, temperature-actuated switches, embedded in motor windings with triple redundancy, normally-closed (open at high temperature), pre-calibrated by manufacturer, automatic reset after decrease in temperature.

12. Rating: Continuous, Inverter. Duty NEMA MG-1, Part 31.

13. Nameplate: NEMA standard stainless steel. Shall also include NEMA efficiency rating, bearing information, number of starts per hour.

14. Standards: Conform to latest issue of IEEE, ANSI, and NEMA.

15. Ground Pad: There shall be a grounding pad near the base of the motor.

16. Size motor to be non-overloading at start-up pressure.

17. High Temperature Shutoff: Control circuit to include high temperature shutoff tied to probe in discharge connection.

18. Motor shall be provided with an OSHA approved belt guard.

19. Oversized and rotatable conduit box.

C. V-Belt:

1. High-capacity type, oil and heat resistant, static-dissipating drive belts selected to have a 1.4 or higher service factor above the required compressor brake horsepower. Sheaves shall mount to the compressor and motor shafts with QD type bushings. A jack-shaft or drive coupling shall be used if recommended by the system manufacturer.

D. Drive Guard:

1. Top, sides and bottom made of 14-gauge sheet steel with expanded metal front and back. Designed to allow ample ventilation for the drive, have an easy access cover and conform to applicable safety codes.

E. Base:

1. A steel angle or channel skeleton-frame base, elevated on legs, with continuous welded joints shall be supplied. Bare base weight shall equal 50 percent or more of the compressor's weight, but not less than 100 pounds. The inlet filter, inlet silencer, compressor, motor, drive, drive guard, discharge silencer, valves, interconnecting piping, supports and all other accessories shall be shipped assembled on the base to the extent allowable by trucking.

2. The systems shall be mirrored so that the belt guards face one another when placed in parallel operation.

F. The timing gears shall be mounted on the impeller shafts on a tapered fit and properly secured. The impeller/shaft shall be supported by cylindrical roller bearings sized for a minimum B 10 life of 100,000 hours.

G. Seismic Requirements: Manufacturer to provide for anchoring provisions, where required, in accordance with the requirements of Section 13 05 41, "Seismic Restraint Requirements for Nonstructural Components", sufficient for proper anchoring and installation of the pumps and equipment. Seismic calculations to be provided by an Engineer designated as a Washington State Registered Structural Engineer.

H. Accessories:

1. Inlet filter:

a. Each blower shall have a filter with a paper media that removes 99.5 percent of 2 micron particles. The maximum pressure drop across the clean element at blower maximum rated maximum shall be less than 2 inches of water column.

b. Filter shall be shipped installed on the inlet silencer and positioned for indoor service. Filter shall be Westwood EMOP.

2. Silencers:

a. Silencers 3 inches and smaller shall be of the premium, straight-through absorptive type. Larger silencers shall be of the multiple-chamber design. Silencers will have acoustically packed nozzle next to blowers operating above transition speed. Silencers with threaded connections shall have ports on each end and those with flanged connections will have ports on the side and end. Multi-chamber silencer attenuation performance shall be at least 18 dB at 63 hertz, 23 dB at 125 hertz, 27 dB at 250 hertz and 31 dB at 500 hertz.

b. Each blower shall have an inlet silencer with an air velocity of 4,000 to 5,700 feet per minute. Silencer shall be Progentex, Inc. series DS, RSI, DRSI, Universal Silencer, Inc. series U5, URB, RIS, Burgess Manning series CA, BMAI, BMSI Stoddard series L/C21, D13/L41, L61/63 or equal. Combination type inlet filter/silencers shall not be permitted.

c. Each blower shall have a discharge silencer. Based on inlet CFM air velocity shall be 5,500 to 7,000 feet per minute. Silencer shall be Progentex, Inc. series DS, RS, DRS, Universal Silencer, Inc. series U5, URB, SD, Burgess Manning series CA, BMA, BMSS, Stoddard series L/C21, D13, D32/33 or equal. Combination type discharge silencer/base frames shall not be permitted.

3. Flexible Joint:

a. Each blower shall have a discharge flexible joint that matches the compressor ports' size and type of connection. The joint's elastomer must be rated higher than the maximum expected service temperature and pressure.

I. Valves:

1. Pressure Relief Valve:

a. Each blower shall be protected by a stacked weight type pressure relief valve preset to start opening at half a PSIG above the PSIG listed in the "service" section, be full open at not more than 10 percent above the set pressure, and rated for the SCFM and PSIG listed in the "service" section. Valve shall be shipped loose for field installation.

2. Double Disc Check Valve:

    a. Each blower shall have a discharge check valve with wafer connection, cast-iron body, cast-iron split discs and seal rated above the maximum anticipated discharge temperature. Valve shall be shipped loose for field installation.

3. Isolation Valve:

    a. Each blower shall have a discharge isolation valve. Valves 2 inches and larger shall be cast-iron wafer-body butterfly type with a locking handle. Valves more than 7.5 feet above the floor shall have a chain wheel operator. The temperature rating of the seat must exceed the maximum anticipated discharge temperature. The valve shall be shipped loose for field installation.

J. Instruments:

1. Requirements: Section 40 70 00, “Instrumentation for Process Systems”.

2. Filter Restriction Gauge:

    a. Each inlet filter shall have a filter restriction gauge that progressively measures vacuum in the filter element. Gauge shall be WIKA 985575.

3. Pressure Gauge:

    a. Each blower shall have a 2-1/2-inch diameter, stainless steel case, brass bourdon tube, liquid filled, 1/4 NPT connection pressure gauge with a 0-15 PSIG scale on systems operating up to 15 PSIG. Gauge shall have a 1/4-inch brass snubber and isolation valve. Gauge shall be Winters PFQ901.

4. Thermometer:

    a. Each blower shall have a 3-inch diameter, hermetically-sealed stainless-steel case and ring, glass window, external zero calibrator, 1 percent accuracy, bimetal-type thermometer with a 50-300 degrees F scale on systems up to 10 PSIG, 50-500 degrees F for higher pressure and a corrosion resistant thermowell. The thermometer shall be Winters TBM3.

5. Temperature Switch:

    a. Each blower shall have a high discharge air temperature switch. Switch shall be UE E402 or approved equal.

    b. A temperature sensor and cutout switch shall be included to shut off blower in the event of high temperature discharge air.

6. Pressure Switch:

    a. Each blower shall have a high discharge pressure switch. Switch shall be UE H402-144 or approved equal.

7. Filter Differential Vacuum Switch:

    a. Each filter shall have a differential vacuum switch factory preset at 20 inches WC vacuum. Switch shall be Dwyer 183-20.

8. Vibration Switches:

    a. Each blower shall have a high vibration switch. Switch shall be Metrix 440SR or approved equal.

9. Flexible Connectors:

    a. The blower shall be provided with single arch flexible connectors on the outlet side to eliminate any stresses on the blower. The flexible connectors shall have flanged ends suitable for service pressure of 15 psig maximum and 300 degrees F temperature. The connector shall be constructed of chlorobutyl with a fiberglass/Kevlar fabric and shall be specifically designed for service at elevated temperatures.

10. Oil Level Switches:

    a. Each blower shall have a low oil level switch. Switch shall be Murphy L150K1 or equal.

11. Junction Box:

    a. Each blower system shall have a painted steel or SST factory-mounted and wired NEMA 4 junction box. Each junction box shall have terminals for field connection for all switches, sensors, and ventilation fan connection.

    b. Provide Form C contacts with NC operation for Blower outputs.

K. Coatings:

1. All equipment shall be cleaned to SSPC-SP 3 and receive a 2-3 millimeter DFT shop coat of phenolic alkyd, zinc-chromate, red iron oxide, rust inhibitive universal primer. The blower systems shall then receive a finish coat of Coronado Alkyd Enamel, 139 series, 50 percent gloss, high temperature paint. The coat shall be 2-3 millimeter DFT.

L. Access for Oil Change: The unit will be supplied with easy access for changing oil. This may include a connection to the oil pan with valve and hose for ease in changing blower oil.

M. Manuals:

1. One operation and maintenance manual shall be provided.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Furnish, install, finish, and place in service the blower and all appurtenances in accordance with the manufacturer's recommendations.

B. Following installation but prior to start-up or testing, the Manufacturer shall send a representative to the jobsite to inspect the installation. Any deficiencies noted during the Manufacturer's inspection must be corrected prior to start-up or testing. The manufacturer shall note his findings in a written acceptance of the installation of each blower and submit copies to the Owner, Engineer, and Contractor.

C. The Contractor shall remedy the deficiencies noted by the Manufacturer. The Manufacturer shall re-inspect the installation and this process shall be repeated until the Manufacturer finds the equipment to be installed in accordance with its recommendations and requirements.

D. Upon finding of satisfactory installation, and prior to start-up or testing, the Manufacturer shall issue a Certificate of Proper Installation and provide a copy to the Engineer. Start-up and testing may begin once the Engineer has received the Certificate of Proper Installation from the Manufacturer.

E. In addition to the above, the Manufacturer shall be present at the jobsite for a minimum of one 8 hour day, exclusive of travel time, to fully train the Owner's personnel in the proper operation and maintenance of the equipment.

3.02 START-UP AND TESTING

A. The manufacturer's representative shall visit the site to provide on-site start-up and testing assistance as outlined in Section 3.03. The blower shall be tested to ensure proper operation of each component and to demonstrate that the total system performs as specified. The installation contractor shall be responsible for field testing.

B. The field tests shall demonstrate that under all conditions of operation, each unit:

1. Has not been damaged by transportation or installation.

2. Has been properly installed.

3. Has no mechanical defect.

4. Is in proper alignment.

5. Has been properly connected.

6. Is free of overheating of any parts.

7. Is free of all objectionable vibration.

8. Is free of excessive noise.

9. Is free of overloading of any parts.

10. Shall operate as specified.

11. Meets the performance requirements indicated in this specification.

3.03 MANUFACTURER'S REPRESENTATIVE

A. The service of a qualified representative of the manufacturer shall be provided to inspect the installation of the equipment, make any necessary adjustments, test, and place the equipment in satisfactory operating condition. The manufacturer shall also instruct the plant operating personnel in the operation and maintenance of the equipment.

B. The manufacturer shall provide one trip (one 8-hour day) to the project site for equipment installation assistance to the Contractor by a qualified factory authorized representative.

C. After installation of all plant equipment has been completed and as soon as conditions permit, the manufacturer shall provide as required by Contractor one trip (one 8-hour day) to conduct an acceptance test under actual operating conditions, to determine the operation is satisfactory and free from excessive vibration as defined by the blower manufacturer. The test shall consist of 3 hours operation of each blower with readings taken and recorded as directed by the manufacturer.

D. Manufacturer's qualified representative shall provide 8 hours of on-site training, travel time excluded. Training details to be submitted 3 weeks prior to scheduled training.

END OF SECTION

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Appendix A

Wages

General Decision Number: WA180001 01/12/2018 WA1

Superseded General Decision Number: WA20170001

State: Washington

Construction Type: Highway

Counties: Washington Statewide.

HIGHWAY (Excludes D.O.E. Hanford Site in Benton and Franklin Counties)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.35 for calendar year 2018 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.35 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2018. The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/05/2018
1	**01/12/2018**

CARP0001-008 06/01/2017

	Rates	Fringes
CARPENTER		
GROUP 1	$ 32.32	16.14
GROUP 2	$ 43.42	18.44
GROUP 3	$ 33.41	16.14
GROUP 4	$ 32.32	16.14
GROUP 5	$ 75.16	16.14
GROUP 6	$ 36.58	16.14
GROUP 7	$ 37.58	16.14
GROUP 8	$ 34.41	16.14
GROUP 9	$ 40.58	16.14

CARPENTER & DIVER CLASSIFICATIONS:

GROUP 1: Carpenter

GROUP 2: Millwright, machine erector

GROUP 3: Piledriver - includes driving, pulling, cutting, placing collars, setting, welding, or creosote treated material, on all piling

GROUP 4: Bridge carpenters

GROUP 5: Diver Wet

GROUP 6: Diver Tender, Manifold Operator, ROV Operator

GROUP 7: Diver Standby, Bell/Vehicle or Submersible operator Not Under Pressure

GROUP 8: Assistant Tender, ROV Tender/Technician

GROUP 9: Manifold Operator-Mixed Gas

ZONE PAY:

ZONE 1	0-40 MILES	FREE
ZONE 2	41-65 MILES	$2.25/PER HOUR
ZONE 3	66-100 MILES	$3.25/PER HOUR
ZONE 4	OVER 100 MILES	$4.75/PER HOUR

DISPATCH POINTS:

CARPENTERS/MILLWRIGHTS: PASCO (515 N Neel Street) or Main Post Office of established residence of employee (Whichever is closest to the worksite).

CARPENTERS/PILEDRIVER: SPOKANE (127 E. AUGUSTA AVE.) or Main Post Office of established residence of employee (Whichever is closest to the worksite).

CARPENTERS: WENATCHEE (27 N. CHELAN) or Main Post Office of established residence of employee (Whichever is closest to the worksite).

CARPENTERS: COEUR D' ALENE (1839 N. GOVERNMENT WAY) or Main Post Office of established residence of employee (Whichever is closest to the worksite).

CARPENTERS: MOSCOW (302 N. JACKSON) or Main Post Office of established residence of employee (Whichever is closest to the worksite).

DEPTH PAY FOR DIVERS BELOW WATER SURFACE:
50-100 feet $2.00 per foot
101-150 feet $3.00 per foot
151-220 feet $4.00 per foot
221 feet and deeper $5.00 per foot

PREMIUM PAY FOR DIVING IN ENCLOSURES WITH NO VERTICAL ASCENT:
0-25 feet Free
26-300 feet $1.00 per Foot

SATURATION DIVING:
The standby rate applies until saturation starts. The saturation diving rate applies when divers are under pressure continuously until work task and decompression are complete. the diver rate shall be paid for all saturation hours.

WORK IN COMBINATION OF CLASSIFICATIONS:
Employees working in any combination of classifications within the diving crew (except dive supervisor) in a shift are paid in the classification with the highest rate for that shift.

HAZMAT PROJECTS:

Anyone working on a HAZMAT job (task), where HAZMAT certification is required, shall be compensated at a premium, in addition to the classification working in as follows:

LEVEL D + $.25 per hour - This is the lowest level of protection. No respirator is used and skin protection is minimal.

LEVEL C + $.50 per hour - This level uses an air purifying respirator or additional protective clothing.

LEVEL B + $.75 per hour - Uses same respirator protection as Level A. Supplied air line is provided in conjunction with a chemical "splash suit".

LEVEL A +$1.00 per hour - This level utilizes a fully encapsulated suit with a self-contained breathing apparatus or a supplied air line.

CARP0003-006 10/01/2011

SOUTHWEST WASHINGTON: CLARK, COWLITZ, KLICKITAT, LEWIS(Piledriver only), PACIFIC (South of a straight line made by extending the north boundary line of Wahkiakum County west to Willapa Bay to the Pacific Ocean), SKAMANIA AND WAHKIAKUM COUNTIES and INCLUDES THE ENTIRE PENINSULA WEST OF WILLAPA BAY

SEE ZONE DESCRIPTION FOR CITIES BASE POINTS

ZONE 1:

	Rates	Fringes
Carpenters:		
CARPENTERS	$ 32.04	14.18
DIVERS TENDERS	$ 36.34	14.18
DIVERS	$ 77.08	14.18
DRYWALL	$ 27.56	14.18
MILLWRIGHTS	$ 32.19	14.18
PILEDRIVERS	$ 33.04	14.18

DEPTH PAY:
50 TO 100 FEET $1.00 PER FOOT OVER 50 FEET
101 TO 150 FEET $1.50 PER FOOT OVER 101 FEET
151 TO 200 FEET $2.00 PER FOOT OVER 151 FEET

Zone Differential (Add up Zone 1 rates):
Zone 2 - $0.85
Zone 3 - 1.25
Zone 4 - 1.70
Zone 5 - 2.00
Zone 6 - 3.00

BASEPOINTS: ASTORIA, LONGVIEW, PORTLAND, THE DALLES, AND VANCOUVER, (NOTE: All dispatches for Washington State Counties: Cowlitz, Wahkiakum and Pacific shall be from Longview Local #1707 and mileage shall be computed from that point.)

ZONE 1: Projects located within 30 miles of the respective city hall of the above mentioned cities
ZONE 2: Projects located more than 30 miles and less than 40 miles of the respective city of the above mentioned cities
ZONE 3: Projects located more than 40 miles and less than 50 miles of the respective city of the above mentioned cities
ZONE 4: Projects located more than 50 miles and less than 60 miles of the respective city of the above mentioned cities.
ZONE 5: Projects located more than 60 miles and less than 70 miles of the respective city of the above mentioned cities
ZONE 6: Projects located more than 70 miles of the respected city of the above mentioned cities

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CARP0770-003 06/01/2015

	Rates	Fringes
CARPENTER		
CENTRAL WASHINGTON: CHELAN, DOUGLAS (WEST OF THE 120TH MERIDIAN), KITTITAS, OKANOGAN (WEST OF THE 120TH MERIDIAN) AND YAKIMA COUNTIES		
CARPENTERS ON CREOSOTE MATERIAL	$ 40.46	13.66
CARPENTERS	$ 40.36	13.66
DIVERS TENDER	$ 35.02	14.00
DIVERS	$ 73.44	14.00
MILLWRIGHT AND MACHINE ERECTORS	$ 41.86	13.66
PILEDRIVER, DRIVING, PULLING, CUTTING, PLACING COLLARS, SETTING, WELDING OR CRESOTE TREATED MATERIAL, ALL PILING	$ 40.61	13.66

(HOURLY ZONE PAY: WESTERN AND CENTRAL WASHINGTON - ALL CLASSIFICATIONS EXCEPT MILLWRIGHTS AND PILEDRIVERS

Hourly Zone Pay shall be paid on jobs located outside of the free zone computed from the city center of the following listed cities:

Seattle	Olympia	Bellingham
Auburn	Bremerton	Anacortes
Renton	Shelton	Yakima
Aberdeen-Hoquiam	Tacoma	Wenatchee
Ellensburg	Everett	Port Angeles
Centralia	Mount Vernon	Sunnyside
Chelan	Pt. Townsend	

Zone Pay:	
0 -25 radius miles	Free
26-35 radius miles	$1.00/hour
36-45 radius miles	$1.15/hour
46-55 radius miles	$1.35/hour
Over 55 radius miles	$1.55/hour

(HOURLY ZONE PAY: WESTERN AND CENTRAL WASHINGTON - MILLWRIGHT AND PILEDRIVER ONLY)

Hourly Zone Pay shall be computed from Seattle Union Hall, Tacoma City center, and Everett City center

Zone Pay:	
0 -25 radius miles	Free
26-45 radius miles	$ .70/hour
Over 45 radius miles	$1.50/hour

CARP0770-006 06/01/2016

	Rates	Fringes
CARPENTER		
WESTERN WASHINGTON: CLALLAM, GRAYS HARBOR,ISLAND, JEFFERSON, KING, KITSAP, LEWIS (excludes piledrivers only), MASON,PACIFIC (North of a straight line made by extending the north boundary line of Wahkiakum County west to the Pacific Ocean), PIERCE, SAN JUAN,SKAGIT, SNOHOMISH, THURSTON AND WHATCOM COUNTIES		
BRIDGE CARPENTERS.....	$ 40.92	14.59
CARPENTERS ON CREOSOTE MATERIAL.....	$ 40.46	13.66
CARPENTERS.....	$ 40.92	14.59
DIVERS TENDER.....	$ 44.67	13.66
DIVERS.....	$ 93.56	13.66
MILLWRIGHT AND MACHINE ERECTORS.....	$ 41.86	13.66
PILEDRIVER, DRIVING, PULLING, CUTTING, PLACING COLLARS, SETTING, WELDING OR CRESOTE TREATED MATERIAL, ALL PILING.....	$ 40.61	13.66

(HOURLY ZONE PAY: WESTERN AND CENTRAL WASHINGTON - ALL CLASSIFICATIONS EXCEPT MILLWRIGHTS AND PILEDRIVERS

Hourly Zone Pay shall be paid on jobs located outside of the free zone computed from the city center of the following listed cities:

Seattle	Olympia	Bellingham
Auburn	Bremerton	Anacortes
Renton	Shelton	Yakima
Aberdeen-Hoquiam	Tacoma	Wenatchee
Ellensburg	Everett	Port Angeles
Centralia	Mount Vernon	Sunnyside
Chelan	Pt. Townsend	

Zone Pay:	
0 -25 radius miles	Free
26-35 radius miles	$1.00/hour
36-45 radius miles	$1.15/hour
46-55 radius miles	$1.35/hour
Over 55 radius miles	$1.55/hour

(HOURLY ZONE PAY: WESTERN AND CENTRAL WASHINGTON - MILLWRIGHT AND PILEDRIVER ONLY)

Hourly Zone Pay shall be computed from Seattle Union Hall, Tacoma City center, and Everett City center

Zone Pay:	
0 -25 radius miles	Free
26-45 radius miles	$ .70/hour
Over 45 radius miles	$1.50/hour

ELEC0046-001 02/06/2017

CALLAM, JEFFERSON, KING AND KITSAP COUNTIES

	Rates	Fringes
CABLE SPLICER	$ 46.87	3%+15.96
ELECTRICIAN	$ 47.56	3%+19.31

ELEC0048-003 01/01/2017

CLARK, KLICKITAT AND SKAMANIA COUNTIES

	Rates	Fringes
CABLE SPLICER	$ 44.22	21.50
ELECTRICIAN	$ 40.20	22.18

HOURLY ZONE PAY:

Hourly Zone Pay shall be paid on jobs located outside of the free zone computed from the city center of the following listed cities:

Portland, The Dalles, Hood River, Tillamook, Seaside and Astoria

Zone Pay:
Zone 1: 31-50 miles $1.50/hour
Zone 2: 51-70 miles $3.50/hour
Zone 3: 71-90 miles $5.50/hour
Zone 4: Beyond 90 miles $9.00/hour

*These are not miles driven. Zones are based on Delorrne Street Atlas USA 2006 plus.

ELEC0048-029 01/01/2017

COWLITZ AND WAHKIAKUM COUNTY

	Rates	Fringes
CABLE SPLICER	$ 44.22	21.50
ELECTRICIAN	$ 40.20	22.18

*** ELEC0073-001 01/01/2018**

ADAMS, FERRY, LINCOLN, PEND OREILLE, SPOKANE, STEVENS, WHITMAN COUNTIES

	Rates	Fringes
CABLE SPLICER	$ 34.10	16.68
ELECTRICIAN	**$ 33.25**	**18.40**

ELEC0076-002 08/30/2017

GRAYS HARBOR, LEWIS, MASON, PACIFIC, PIERCE, AND THURSTON COUNTIES

	Rates	Fringes
CABLE SPLICER	$ 40.05	24.49
ELECTRICIAN	$ 37.86	24.43

ELEC0112-005 06/01/2017

ASOTIN, BENTON, COLUMBIA, FRANKLIN, GARFIELD, KITTITAS, WALLA WALLA, YAKIMA COUNTIES

	Rates	Fringes
CABLE SPLICER	$ 42.95	20.06
ELECTRICIAN	$ 40.90	20.06

ELEC0191-003 06/01/2017

ISLAND, SAN JUAN, SNOHOMISH, SKAGIT AND WHATCOM COUNTIES

	Rates	Fringes
CABLE SPLICER	$ 44.23	17.73
ELECTRICIAN	$ 43.45	19.69

ELEC0191-004 06/01/2017

CHELAN, DOUGLAS, GRANT AND OKANOGAN COUNTIES

	Rates	Fringes
CABLE SPLICER	$ 40.82	17.63
ELECTRICIAN	$ 40.65	19.59

ENGI0302-003 06/01/2017

CHELAN (WEST OF THE 120TH MERIDIAN), CLALLAM, DOUGLAS (WEST OF THE 120TH MERIDIAN), GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP, KITTITAS, MASON, OKANOGAN (WEST OF THE 120TH MERIDIAN), SAN JUNA, SKAGIT, SNOHOMISH, WHATCOM AND YAKIMA (WEST OF THE 120TH MERIDIAN) COUNTIES

Zone 1 (0-25 radius miles):

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
Group 1A	$ 41.90	19.20
Group 1AA	$ 42.52	19.20
Group 1AAA	$ 43.13	19.20
Group 1	$ 41.29	19.20
Group 2	$ 40.76	19.20
Group 3	$ 40.29	19.20
Group 4	$ 37.70	19.20

Zone Differential (Add to Zone 1 rates):
Zone 2 (26-45 radius miles) - $1.00
Zone 3 (Over 45 radius miles) - $1.30

BASEPOINTS: Aberdeen, Bellingham, Bremerton, Everett, Kent, Mount Vernon, Port Angeles, Port Townsend, Seattle, Shelton, Wenatchee, Yakima

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1AAA - Cranes-over 300 tons, or 300 ft of boom (including jib with attachments)

GROUP 1AA - Cranes 200 to 300 tons, or 250 ft of boom (including jib with attachments); Tower crane over 175 ft in height, base to boom

GROUP 1A - Cranes, 100 tons thru 199 tons, or 150 ft of boom (including jib with attachments); Crane-overhead, bridge type, 100 tons and over; Tower crane up to 175 ft in height base to boom; Loaders-overhead, 8 yards and over; Shovels, excavator, backhoes-6 yards and over with attachments

GROUP 1 - Cableway; Cranes 45 tons thru 99 tons, under 150 ft of boom (including jib with attachments); Crane-overhead, bridge type, 45 tons thru 99 tons; Derricks on building work; Excavator, shovel, backhoes over 3 yards and under 6 yards; Hard tail end dump articulating off-road equipment 45 yards and over; Loader- overhead 6 yards to, but not including 8 yards; Mucking machine, mole, tunnel, drill and/or shield; Quad 9, HD 41, D-10; Remote control operator on rubber tired earth moving equipment; Rollagon; Scrapers-self propelled 45 yards and over; Slipform pavers; Transporters, all truck or track type

GROUP 2 - Barrier machine (zipper); Batch Plant Operaor-Concrete; Bump Cutter; Cranes, 20 tons thru 44 tons with attachments; Crane-overhead, bridge type-20 tons through 44 tons; Chipper; Concrete Pump-truck mount with boom attachment; Crusher; Deck Engineer/Deck Winches (power); Drilling machine; Excavator, shovel, backhoe-3yards and under; Finishing Machine, Bidwell, Gamaco and similar equipment; Guardrail punch; Horizontal/directional drill operator; Loaders-overhead under 6 yards; Loaders-plant feed; Locomotives-all; Mechanics-all; Mixers-asphalt plant; Motor patrol graders-finishing; Piledriver (other than crane mount); Roto-mill,roto-grinder; Screedman, spreader, topside operator-Blaw Knox, Cedar Rapids, Jaeger, Caterpillar, Barbar Green; Scraper-self propelled, hard tail end dump, articulating off-road equipment-under 45 yards; Subgrade trimmer; Tractors, backhoes-over 75 hp; Transfer material service machine-shuttle buggy, blaw knox-roadtec; Truck crane oiler/driver-100 tons and over; Truck Mount portable conveyor; Yo Yo Pay dozer

GROUP 3 - Conveyors; Cranes-thru 19 tons with attachments; A-frame crane over 10 tons; Drill oilers-auger type, truck or crane mount; Dozers-D-9 and under; Forklift-3000 lbs. and over with attachments; Horizontal/directional drill locator; Outside hoists-(elevators and manlifts), air tuggers, strato tower bucket elevators; Hydralifts/boom trucks over 10 tons; Loader-elevating type, belt; Motor patrol grader-nonfinishing; Plant oiler- asphalt, crusher; Pumps-concrete; Roller, plant mix or multi-lift materials; Saws-concrete; Scrpers-concrete and carry-all; Service engineer-equipment; Trenching machines; Truck Crane Oiler/Driver under 100 tons; Tractors, backhoe 75 hp and under

GROUP 4 - Assistant Engineer; Bobcat; Brooms; Compressor; Concrete finish mahine-laser screed; Cranes-A frame-10 tons and under; Elevator and Manlift-permanent or shaft type; Gradechecker, Stakehop; Forklifts under 3000 lbs. with attachments; Hydralifts/boom trucks, 10 tons and under; Oil distributors, blower distribution and mulch seeding operator; Pavement breaker; Posthole digger, mechanical; Power plant; Pumps, water; Rigger and Bellman; Roller-other than plant mix; Wheel Tractors, farmall type; Shotcrete/gunite equipment operator

HANDLING OF HAZARDOUS WASTE MATERIALS:

Personnel in all craft classifications subject to working inside a federally designated hazardous perimeter shall be elgible for compensation in accordance with the following group schedule relative to the level of hazardous waste as outlined in the specific hazardous waste project site safety plan.

H-1 Base wage rate when on a hazardous waste site when not outfitted with protective clothing
H-2 Class "C" Suit - Base wage rate plus $ .25 per hour.
H-3 Class "B" Suit - Base wage rate plus $ .50 per hour.
H-4 Class "A" Suit - Base wage rate plus $ .75 per hour.

ENGI0370-002 06/01/2017

ADAMS, ASOTIN, BENTON, CHELAN (EAST OF THE 120TH MERIDIAN), COLUMBIA, DOUGLAS (EAST OF THE 120TH MERIDIAN), FERRY, FRANKLIN, GARFIELD, GRANT, LINCOLN, OKANOGAN (EAST OF THE 120TH MERIDIAN), PEND OREILLE, SPOKANE, STEVENS, WALLA WALLA, WHITMAN AND YAKIMA (EAST OF THE 120TH MERIDIAN) COUNTIES

ZONE 1:

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1	$ 27.11	15.20
GROUP 2	$ 27.43	15.20
GROUP 3	$ 28.04	15.20
GROUP 4	$ 28.20	15.20
GROUP 5	$ 28.36	15.20
GROUP 6	$ 28.64	15.20
GROUP 7	$ 28.91	15.20
GROUP 8	$ 30.01	15.20

ZONE DIFFERENTIAL (Add to Zone 1 rate): Zone 2 - $2.00

Zone 1: Within 45 mile radius of Spokane, Pasco, Washington; Lewiston, Idaho

Zone 2: Outside 45 mile radius of Spokane, Pasco, Washington; Lewiston, Idaho

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Bit Grinders; Bolt Threading Machine; Compressors (under 2000 CFM, gas, diesel, or electric power); Deck Hand; Fireman & Heater Tender; Hydro-seeder, Mulcher, Nozzleman; Oiler Driver, & Cable Tender, Mucking Machine; Pumpman; Rollers, all types on subgrade, including seal and chip coatings (farm type, Case, John Deere & similar, or Compacting Vibrator), except when pulled by Dozer with operable blade; Welding Machine; Crane Oiler-Driver (CLD required) & Cable Tender, Mucking Machine

GROUP 2: A-frame Truck (single drum); Assistant Refrigeration Plant (under 1000 ton); Assistant Plant Operator, Fireman or Pugmixer (asphalt); Bagley or Stationary Scraper; Belt Finishing Machine; Blower Operator (cement); Cement Hog; Compressor (2000 CFM or over, 2 or more, gas diesel or electric power); Concrete Saw (multiple cut); Distributor Leverman; Ditch Witch or similar; Elevator Hoisting Materials; Dope Pots (power agitated); Fork Lift or Lumber Stacker, hydra-lift & similar; Gin Trucks (pipeline); Hoist, single drum; Loaders (bucket elevators and conveyors); Longitudinal Float; Mixer (portable-concrete); Pavement Breaker, Hydra-Hammer & similar; Power Broom; Railroad Ballast Regulation Operator (self-propelled); Railroad Power Tamper Operator (self-propelled); Railroad Tamper Jack Operator (self-propelled; Spray Curing Machine (concrete); Spreader Box (self-propelled); Straddle Buggy (Ross & similar on construction job only); Tractor (Farm type R/T with attachment, except Backhoe); Tugger Operator

GROUP 3: A-frame Truck (2 or more drums); Assistant Refrigeration Plant & Chiller Operator (over 1000 ton); Backfillers (Cleveland & similar); Batch Plant & Wet Mix Operator, single unit (concrete); Belt-Crete Conveyors with power pack or similar; Belt Loader (Kocal or similar); Bending Machine; Bob Cat (Skid Steer); Boring Machine (earth); Boring Machine (rock under 8 inch bit) (Quarry Master, Joy or similar); Bump Cutter (Wayne, Saginau or similar); Canal Lining Machine (concrete); Chipper (without crane); Cleaning & Doping Machine (pipeline); Deck Engineer; Elevating Belt-type Loader (Euclid, Barber Green & similar); Elevating Grader-type Loader (Dumor, Adams or similar); Generator Plant Engineers (diesel or electric); Gunnite Combination Mixer & Compressor; Locomotive Engineer; Mixermobile; Mucking Machine; Posthole Auger or Punch; Pump (grout or jet); Soil Stabilizer (P & H or similar); Spreader Machine; Dozer/Tractor (up to D-6 or equivalent) and Traxcavator; Traverse Finish Machine; Turnhead Operator

GROUP 4: Concrete Pumps (squeeze-crete, flow-crete, pump-crete, Whitman & similar); Curb Extruder (asphalt or concrete); Drills (churn, core, calyx or diamond); Equipment Serviceman; Greaser & Oiler; Hoist (2 or more drums or Tower Hoist); Loaders (overhead & front-end, under 4 yds. R/T); Refrigeration Plant Engineer (under 1000 ton); Rubber-tired Skidders (R/T with or without attachments); Surface Heater & Plant Machine; Trenching Machines (under 7 ft. depth capacity); Turnhead (with re-screening); Vacuum Drill (reverse circulation drill under 8 inch bit)

GROUP 5: Backhoe (under 45,000 gw); Backhoe & Hoe Ram (under 3/4 yd.); Carrydeck & Boom Truck (under 25 tons); Cranes (25 tons & under), all attachments including clamshell, dragline; Derricks & Stifflegs (under 65 tons); Drilling Equipment(8 inch bit & over) (Robbins, reverse circulation & similar); Hoe Ram; Piledriving Engineers; Paving (dual drum); Railroad Track Liner Operaotr (self-propelled); Refrigeration Plant Engineer (1000 tons & over); Signalman (Whirleys, Highline Hammerheads or similar); Grade Checker

GROUP 6: Asphalt Plant Operator; Automatic Subgrader (Ditches & Trimmers)(Autograde, ABC, R.A. Hansen & similar on grade wire); Backhoe (45,000 gw and over to 110,000 gw); Backhoes & Hoe Ram (3/4 yd. to 3 yd.); Batch Plant (over 4 units); Batch & Wet Mix Operator (multiple units, 2 & incl. 4); Blade Operator (motor patrol & attachments); Cable Controller (dispatcher); Compactor (self-propelled with blade); Concrete Pump Boom Truck; Concrete Slip Form Paver; Cranes (over 25 tons, to and including 45 tons), all attachments including clamshell, dragline; Crusher, Grizzle & Screening Plant Operator; Dozer, 834 R/T & similar; Drill Doctor; Loader Operator (front-end & overhead, 4 yds. incl. 8 yds.); Multiple Dozer Units with single blade; Paving Machine (asphalt and concrete); Quad-Track or similar equipment; Rollerman (finishing asphalt pavement); Roto Mill (pavement grinder); Scrapers, all, rubber-tired; Screed Operator; Shovel(under 3 yds.); Trenching Machines (7 ft. depth & over); Tug Boat Operator Vactor guzzler, super sucker; Lime Batch Tank Operator (REcycle Train); Lime Brain Operator (Recycle Train); Mobile Crusher Operator (Recycle Train)

GROUP 7: Backhoe (over 110,000 gw); Backhoes & Hoe Ram (3 yds & over); Blade (finish & bluetop) Automatic, CMI, ABC, Finish Athey & Huber & similar when used as automatic; Cableway Operators; Concrete Cleaning/Decontamination machine operator; Cranes (over 45 tons to but not including 85 tons), all attachments including clamshell and dragine; Derricks & Stiffleys (65 tons & over); Elevating Belt (Holland type); Heavy equipment robotics operator; Loader (360 degrees revolving Koehring Scooper or similar); Loaders (overhead & front-end, over 8 yds. to 10 yds.); Rubber-tired Scrapers (multiple engine with three or more scrapers); Shovels (3 yds. & over); Whirleys & Hammerheads, ALL; H.D. Mechanic; H.D. Welder; Hydraulic Platform Trailers (Goldhofer, Shaurerly andSimilar); Ultra High Pressure Wateriet Cutting Tool System Operator (30,000 psi); Vacuum Blasting Machine Operator

GROUP 8: Cranes (85 tons and over, and all climbing, overhead,rail and tower), all attachments including clamshell, dragline; Loaders (overhead and front-end, 10 yards and over); Helicopter Pilot

BOOM PAY: (All Cranes, Including Tower)
180 ft to 250 ft $ .50 over scale
Over 250 ft $ .80 over scale

NOTE:
In computing the length of the boom on Tower Cranes, they shall be measured from the base of the Tower to the point of the boom.

HAZMAT:
Anyone working on HAZMAT jobs, working with supplied air shall receive $1.00 an hour above classification.

ENGI0612-012 06/01/2014

LEWIS,PIERCE, PACIFIC (portion lying north of a parallel line extending west from the northern boundary of Wahkaikum County to the sea) AND THURSTON COUNTIES

ON PROJECTS DESCRIBED IN FOOTNOTE A BELOW, THE RATE FOR EACH GROUP SHALL BE 90% OF THE BASE RATE PLUS FULL FRINGE BENEFITS. ON ALL OTHER WORK, THE FOLLOWING RATES APPLY.

Zone 1 (0-25 radius miles):

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1A	$ 38.39	17.40
GROUP 1AA	$ 38.96	17.40
GROUP 1AAA	$ 39.52	17.40
GROUP 1	$ 37.84	17.40
GROUP 2	$ 37.35	17.40
GROUP 3	$ 36.93	17.40
GROUP 4	$ 34.57	17.40

Zone Differential (Add to Zone 1 rates):
Zone 2 (26-45 radius miles) = $1.00
Zone 3 (Over 45 radius miles) - $1.30

BASEPOINTS: CENTRALIA, OLYMPIA, TACOMA

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1 AAA - Cranes-over 300 tons or 300 ft of boom (including jib with attachments)

GROUP 1AA - Cranes- 200 tonsto 300 tons, or 250 ft of boom (including jib with attachments; Tower crane over 175 ft in height, bas to boom

GROUP 1A - Cranes, 100 tons thru 199 tons, or 150 ft of boom (including jib with attachments); Crane-overhead, bridge type, 100 tons and over; Tower crane up to 175 ft in height base to boom; Loaders-overhead, 8 yards and over; Shovels, excavator, backhoes-6 yards and over with attachments

GROUP 1 - Cableway; Cranes 45 tons thru 99 tons under 150 ft of boom (including jib with attachments); Crane-overhead, bridge type, 45 tons thru 99 tons; Derricks on building work; Excavator, shovel, backhoes over 3 yards and under 6 yards; Hard tail end dump articulating off-road equipment 45 yards and over; Loader- overhead, 6 yards to, but not including, 8 yards; Mucking machine, mole, tunnel, drill and/or shield; Quad 9 HD 41, D-10; Remote control operator on rubber tired earth moving equipment; Rollagon; Scrapers-self-propelled 45 yards and over; Slipform pavers; Transporters, all track or truck type

GROUP 2 - Barrier machine (zipper); Batch Plant Operator-concrete; Bump Cutter; Cranes, 20 tons thru 44 tons with attachments; Crane-Overhead, bridge type, 20 tons through 44 tons; Chipper; Concrete pump-truck mount with boom attachment; Crusher; Deck engineer/deck winches (power); Drilling machine; Excavator, shovel, backhoe-3 yards and under; Finishing machine, Bidwell, Gamaco and similar equipment; Guardrail punch; Loaders, overhead under 6 yards; Loaders-plant feed; Locomotives-all; Mechanics- all; Mixers, asphalt plant; Motor patrol graders, finishing; Piledriver (other than crane mount); Roto-mill, roto-grinder; Screedman, spreader, topside operator-Blaw Knox, Cedar Rapids, Jaeger, Caterpillar, Barbar Green; Scraper-self- propelled, hard tail end dump, articulating off-road equipment- under 45 yards; Subgrader trimmer; Tractors, backhoe over 75 hp; Transfer material service machine-shuttle buggy, Blaw Knox- Roadtec; Truck Crane oiler/driver-100 tons and over; Truck Mount Portable Conveyor; Yo Yo pay

GROUP 3 - Conveyors; Cranes through 19 tons with attachments; Crane-A-frame over 10 tons; Drill oilers-auger type, truck or crane mount; Dozer-D-9 and under; Forklift-3000 lbs. and over with attachments; Horizontal/directional drill locator; Outside Hoists-(elevators and manlifts), air tuggers, strato tower bucket elevators; Hydralifts/boom trucks over 10 tons; Loaders-elevating type, belt; Motor patrol grader-nonfinishing; Plant oiler- asphalt, crusher; Pump-Concrete; Roller, plant mix or multi-lfit materials; Saws-concrete; Scrapers, concrete and carry all; Service engineers-equipment; Trenching machines; Truck crane oiler/driver under 100 tons; Tractors, backhoe under 75 hp

GROUP 4 - Assistant Engineer; Bobcat; Brooms; Compressor; Concrete Finish Machine-laser screed; Cranes A-frame 10 tons and under; Elevator and manlift (permanent and shaft type); Forklifts-under 3000 lbs. with attachments; Gradechecker, stakehop; Hydralifts/boom trucks, 10 tons and under; Oil distributors, blower distribution and mulch seeding operator; Pavement breaker; Posthole digger-mechanical; Power plant; Pumps-water; Rigger and Bellman; Roller-other than plant mix; Wheel Tractors, farmall type; Shotcrete/gunite equipment operator

FOOTNOTE A- Reduced rates may be paid on the following:
1. Projects involving work on structures such as buildings and bridges whose total value is less than $1.5 million excluding mechanical, electrical, and utility portions of the contract.

2. Projects of less than $1 million where no building is involved. Surfacing and paving included, but utilities excluded.

3. Marine projects (docks, wharfs, etc.) less than $150,000.

HANDLING OF HAZARDOUS WASTE MATERIALS: Personnel in all craft classifications subject to working inside a federally designated hazardous perimeter shall be elgible for compensation in accordance with the following group schedule relative to the level of hazardous waste as outlined in the specific hazardous waste project site safety plan.

H-1 Base wage rate when on a hazardous waste site when not outfitted with protective clothing, Class "D" Suit - Base wage rate plus $ .50 per hour.
H-2 Class "C" Suit - Base wage rate plus $1.00 per hour.
H-3 Class "B" Suit - Base wage rate plus $1.50 per hour.
H-4 Class "A" Suit - Base wage rate plus $2.00 per hour.

*** ENGI0701-002 01/01/2018**

CLARK, COWLITZ, KLICKKITAT, PACIFIC (SOUTH), SKAMANIA, AND WAHKIAKUM COUNTIES

POWER RQUIPMENT OPERATORS: ZONE 1

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1	**$ 41.65**	**14.35**
GROUP 1A	**$ 43.73**	**14.35**
GROUP 1B	**$ 45.82**	**14.35**
GROUP 2	**$ 39.74**	**14.35**
GROUP 3	**$ 38.59**	**14.35**
GROUP 4	**$ 37.51**	**14.35**
GROUP 5	**$ 36.27**	**14.35**
GROUP 6	**$ 33.05**	**14.35**

Zone Differential (add to Zone 1 rates):
Zone 2 - $3.00
Zone 3 - $6.00

For the following metropolitan counties: MULTNOMAH; CLACKAMAS; MARION; WASHINGTON; YAMHILL; AND COLUMBIA; CLARK; AND COWLITZ COUNTY, WASHINGTON WITH MODIFICATIONS AS INDICATED:

All jobs or projects located in Multnomah, Clackamas and Marion Counties, West of the western boundary of Mt. Hood National Forest and West of Mile Post 30 on Interstate 84 and West of Mile Post 30 on State Highway 26 and West of Mile Post 30 on Highway 22 and all jobs or projects located in Yamhill County, Washington County and Columbia County and all jobs or porjects located in Clark & Cowlitz County, Washington except that portion of Cowlitz County in the Mt. St. Helens "Blast Zone" shall receive Zone I pay for all classifications.

All jobs or projects located in the area outside the identified boundary above, but less than 50 miles from the Portland City Hall shall receive Zone II pay for all classifications.

All jobs or projects located more than 50 miles from the Portland City Hall, but outside the identified border above, shall receive Zone III pay for all classifications.

For the following cities: ALBANY; BEND; COOS BAY; EUGENE; GRANTS PASS; KLAMATH FALLS; MEDFORD; ROSEBURG

All jobs or projects located within 30 miles of the respective city hall of the above mentioned cities shall receive Zone I pay for all classifications.

All jobs or projects located more than 30 miles and less than 50 miles from the respective city hall of the above mentioned cities shall receive Zone II pay for all classifications.

All jobs or projects located more than 50 miles from the respective city hall of the above mentioned cities shall receive Zone III pay for all classifications.

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

Group 1 Concrete Batch Plan and or Wet mix three (3) units or more; Crane, Floating one hundred and fifty (150) ton but less than two hundred and fifty (250) ton; Crane, two hundred (200) ton through two hundred ninety nine (299) ton with two hundred foot (200') boom or less (including jib, inserts and/or attachments); Crane, ninety (90) ton through one hundred ninety nine (199) ton with over two hundred (200') boom Including jib, inserts and/or attachments); Crane, Tower Crane with one hundred seventy five foot (175') tower or less and with less than two hundred foot (200') jib; Crane, Whirley ninety (90) ton and over; Helicopter when used in erecting work

Group 1A Crane, floating two hundred fifty (250) ton and over; Crane, two hundred (200) ton through two hundred ninety nine (299) ton, with over two hundred foot (200') boom (including jib, inserts and/or attachments); Crane, three hundred (300) ton through three hundred ninety nine (399) ton; Crane, Tower Crane with over one hundred seventy five foot (175') tower or over two hundred foot (200') jib; Crane, tower Crane on rail system or 2nd tower or more in work radius

Group 1B Crane, three hundred (300) ton through three hundred ninety nine (399) ton, with over two hundred foot (200') boom (including jib, inserts and/or attachments); Floating crane, three hundred fifty (350) ton and over; Crane, four hundred (400) ton and over

Group 2 Asphalt Plant (any type); Asphalt Roto-Mill, pavement profiler eight foot (8') lateral cut and over; Auto Grader or "Trimmer"; Blade, Robotic; Bulldozer, Robotic Equipment (any type); Bulldozer, over one hundred twenty thousand (120,000) lbs. and above; Concrete Batch Plant and/or Wet Mix one (1) and two (2) drum; Concrete Diamond Head Profiler; Canal Trimmer; Concrete, Automatic Slip Form Paver (Assistant to the Operator required); Crane, Boom Truck fifty (50) ton and with over one hundred fifty foot (150') boom and over; Crane, Floating (derrick barge) thirty (30) ton but less than one hundred fifty (150) ton; Crane, Cableway twenty-five (25) ton and over; Crane, Floating Clamshell three (3) cu. Yds. And over; Crane, ninety (90) ton through one hundred ninety nine (199) ton up to and including two hundred foot (200') of boom (including jib inserts and/or attachments); Crane, fifty (50) ton through eighty nine (89) ton with over one hundred fifty foot (150') boom (including jib inserts and/or attachments); Crane, Whirley under ninety (90) ton; Crusher Plant; Excavator over one hundred thirty thousand (130,000) lbs.; Loader one hundred twenty thousand (120,000) lbs. and above; Remote Controlled Earth Moving Equipment; Shovel, Dragline, Clamshell, five (5) cu. Yds. And over; Underwater Equipment remote or otherwise, when used in construction work; Wheel Excavator any size

Group 3 Bulldozer, over seventy thousand (70,000) lbs. up to and including one hundred twenty thousand (120,000) lbs.; Crane, Boom Truck fifty (50) ton and over with less than one hundred fifty foot (150') boom; Crane, fifty (50) ton through eighty nine (89) ton with one hundred fifty foot (150') boom or less (including jib inserts and/or attachments); Crane, Shovel, Dragline or Clamshell three (3) cu. yds. but less than five (5) cu. Yds.; Excavator over eighty thousand (80,000) lbs. through one hundred thirty thousand (130,000) lbs.; Loader sixty thousand (60,000) lbs. and less than one hundred twenty thousand (120,000) lbs.

Group 4 Asphalt, Screed; Asphalt Paver; Asphalt Roto-Mill, pavement profiler, under eight foot (8') lateral cut; Asphalt, Material Transfer Vehicle Operator; Back Filling Machine; Backhoe, Robotic, track and wheel type up to and including twenty thousand (20,000) lbs. with any attachments; Blade (any type); Boatman; Boring Machine; Bulldozer over twenty thousand (20,000) lbs. and more than one hundred (100) horse up to seventy thousand (70,000) lbs.; Cable-Plow (any type); Cableway up to twenty five (25) ton; Cat Drill (John Henry); Chippers; Compactor, multi-engine; Compactor, Robotic; Compactor with blade self-propelled; Concrete, Breaker; Concrete, Grout Plant; Concrete, Mixer Mobile; Concrete, Paving Road Mixer; Concrete, Reinforced Tank Banding Machine; Crane, Boom Truck twenty (20) ton and under fifty (50) ton; Crane, Bridge Locomotive, Gantry and Overhead; Crane, Carry Deck; Crane, Chicago Boom and similar types; Crane, Derrick Operator, under one hundred (100) ton; Crane, Floating Clamshell, Dragline, etc. Operator, under three (3) cu. yds. Or less than thirty (30) ton; Crane, under fifty (50) ton; Crane, Quick Tower under one hundred foot (100') in height and less than one hundred fifty foot (150') jib (on rail included); Diesel-Electric Engineer (Plant or Floating); Directional Drill over twenty thousand (20,000) lbs. pullback; Drill Cat Operator; Drill Doctor and/or Bit Grinder; Driller, Percussion, Diamond, Core, Cable, Rotary and similar type; Excavator Operator over twenty thousand (20,000) lbs. through eighty thousand (80,000) lbs.; Generator Operator; Grade-all; Guardrail Machines, i.e. punch, auger, etc.; Hammer Operator (Piledriver); Hoist, stiff leg, guy derrick or similar type, fifty (50) ton and over; Hoist, two (2) drums or more; Hydro Axe (loader mounted or similar type); Jack Operator, Elevating Barges, Barge Operator, self-unloading; Loader Operator, front end and overhead, twenty five thousand (25,000) lbs. and less than sixty thousand (60,000) lbs.; Log Skidders; Piledriver Operator (not crane type); Pipe, Bending, Cleaning, Doping and Wrapping Machines; Rail, Ballast Tamper Multi-Purpose; Rubber-tired Dozers and Pushers; Scraper, all types; Side-Boom; Skip Loader, Drag Box; Strump Grinder (loader mounted or similar type); Surface Heater and Planer; Tractor, rubber-tired, over fifty (50) HP Flywheel; Trenching Machine three foot (3') depth and deeper; Tub Grinder (used for wood debris); Tunnel Boring Machine Mechanic; Tunnel, Mucking Machine;

Ultra High Pressure Water Jet Cutting Tool System Operator; Vacuum Blasting Machine Operator; Water pulls, Water wagons

Group 5 Asphalt, Extrusion Machine; Asphalt, Roller (any asphalt mix); Asphalt, Roto-Mill pavement profiler ground man; Bulldozer, twenty thousand (20,000) lbs. or less, or one hundred (100) horse or less; Cement Pump; Chip Spreading Machine; Churn Drill and Earth Boring Machine; Compactor, self-propelled without blade; Compressor, (any power) one thousand two hundred fifty (1,250) cu. ft. and over, total capacity; Concrete, Batch Plant Quality control; Concrete, Combination Mixer and compressor operator, gunite work; Concrete, Curb Machine, Mechanical Berm, Curb and/or Curb and Gutter; Concrete, Finishing Machine; Concrete, Grouting Machine; Concrete, Internal Full Slab Vibrator Operator; Concrete, Joint Machine; Concrete, Mixer single drum, any capacity; Concrete, Paving Machine eight foot (8') or less; Concrete, Planer; Concrete, Pump; Concrete, Pump Truck; Concrete, Pumpcrete Operator (any type); Concrete, Slip Form Pumps, power driven hydraulic lifting device for concrete forms; Conveyored Material Hauler; Crane, Boom Truck under twenty (20) tons; Crane, Boom Type lifting device, five (5) ton capacity or less; Drill, Directional type less than twenty thousand (20,000) lbs. pullback; Fork Lift, over ten (10) ton or Robotic; Helicopter Hoist; Hoist Operator, single drum; Hydraulic Backhoe track type up to and including twenty thousand (20,000) lbs.; Hydraulic Backhoe wheel type (any make); Laser Screed; Loaders, rubber-tired type, less than twenty five thousand (25,000) lbs.; Pavement Grinder and/or Grooving Machine (riding type); Pipe, cast in place Pipe Laying Machine; Pulva-Mixer or similar types; Pump Operator, more than five (5) pumps (any size); Rail, Ballast Compactor, Regulator, or Tamper machines; Service Oiler (Greaser); Sweeper Self-Propelled; Tractor, Rubber-Tired, fifty (50) HP flywheel and under; Trenching Machine Operator, maximum digging capacity three foot (3') depth; Tunnel, Locomotive, Dinkey; Tunnel, Power Jumbo setting slip forms, etc.

Group 6 Asphalt, Pugmill (any type); Asphalt, Raker; Asphalt, Truck Mounted Asphalt Spreader, with Screed; Auger Oiler; Boatman; Bobcat, skid steed (less than one (1) yard); Broom, self-propelled; Compressor Operator (any power) under 1,250 cu. ft. total capacity; Concrete Curing Machine (riding type); Concrete Saw; Conveyor Operator or Assistant; Crane, Tugger; Crusher Feederman; Crusher Oiler; Deckhand; Drill, Directional Locator; Fork Lift; Grade Checker; Guardrail Punch Oiler; Hydrographic Seeder Machine, straw, pulp or seed; Hydrostatic Pump Operator; Mixer Box (CTB, dry batch, etc.); Oiler; Plant Oiler; Pump (any power); Rail, Brakeman, Switchman, Motorman; Rail, Tamping Machine, mechanical, self-propelled; Rigger; Roller grading (not asphalt); Truck, Crane Oiler-Driver

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IRON0014-005 07/01/2016

ADAMS, ASOTIN, BENTON, COLUMBIA, DOUGLAS, FERRY, FRANKLIN, GARFIELD, GRANT, LINCOLN, OKANOGAN, PEND ORIELLE, SPOKANE, STEVENS, WALLA WALLA AND WHITMAN COUNTIES

	Rates	Fringes
IRONWORKER	$ 32.89	24.56

IRON0029-002 07/01/2015

CLARK, COWLITZ, KLICKITAT, PACIFIC, SKAMANIA, AND WAHKAIKUM COUNTIES

	Rates	Fringes
IRONWORKER	$ 34.12	23.04

IRON0086-002 07/01/2016

YAKIMA, KITTITAS AND CHELAN COUNTIES

	Rates	Fringes
IRONWORKER	$ 32.89	24.56

IRON0086-004 07/01/2016

CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP, LEWIS, MASON, PIERCE, SKAGIT, SNOHOMISH, THURSTON, AND WHATCOM COUNTIES

	Rates	Fringes
IRONWORKER	$ 40.52	24.71

LABO0238-004 06/01/2017

PASCO AREA: ADAMS, BENTON, COLUMBIA,DOUGLAS (East of 120th Meridian), FERRY, FRANKLIN, GRANT, OKANOGAN, WALLA WALLA

SPOKANE AREA: ASOTIN, GARFIELD, LINCOLN, PEND OREILLE, SPOKANE, STEVENS & WHITMAN COUNTIES

	Rates	Fringes
LABORER (PASCO)		
GROUP 1	$ 24.66	11.30
GROUP 2	$ 26.76	11.30
GROUP 3	$ 27.03	11.30
GROUP 4	$ 27.30	11.30
GROUP 5	$ 27.58	11.30
LABORER (SPOKANE)		
GROUP 1	$ 24.66	11.30
GROUP 2	$ 26.76	11.30
GROUP 3	$ 27.03	11.30
GROUP 4	$ 27.30	11.30
GROUP 5	$ 27.58	11.30

Zone Differential (Add to Zone 1 rate): $2.00

BASE POINTS: Spokane, Pasco, Lewiston

Zone 1: 0-45 radius miles from the main post office.
Zone 2: 45 radius miles and over from the main post office.

LABORERS CLASSIFICATIONS

GROUP 1: Flagman; Landscape Laborer; Scaleman; Traffic Control Maintenance Laborer (to include erection and maintenance of barricades, signs and relief of flagperson); Window Washer/Cleaner (detail cleanup, such as, but not limited to cleaning floors, ceilings, walls, windows, etc. prior to final acceptance by the owner)

GROUP 2: Asbestos Abatement Worker; Brush Hog Feeder; Carpenter Tender; Cement Handler; Clean-up Laborer; Concrete Crewman (to include stripping of forms, hand operating jacks on slip form construction, application of concrete curing compounds, pumpcrete machine, signaling, handling the nozzle of squeezcrete or similar machine,6 inches and smaller); Confined Space Attendant; Concrete Signalman; Crusher Feeder; Demolition (to include clean-up, burning, loading, wrecking and salvage of all material); Dumpman; Fence Erector; Firewatch; Form Cleaning Machine Feeder, Stacker; General Laborer; Grout Machine Header Tender; Guard Rail (to include guard rails, guide and reference posts, sign posts, and right-of-way markers); Hazardous Waste Worker, Level D (no respirator is used and skin protection is minimal); Miner, Class "A" (to include all bull gang, concrete crewman, dumpman and pumpcrete

crewman, including distributing pipe, assembly & dismantle, and nipper); Nipper; Riprap Man; Sandblast Tailhoseman; Scaffold Erector (wood or steel); Stake Jumper; Structural Mover (to include separating foundation, preparation, cribbing, shoring, jacking and unloading of structures); Tailhoseman (water nozzle); Timber Bucker and Faller (by hand); Track Laborer (RR); Truck Loader; Well-Point Man; All Other Work Classifications Not Specially Listed Shall Be Classified As General Laborer

GROUP 3: Asphalt Roller, walking; Cement Finisher Tender; Concrete Saw, walking; Demolition Torch; Dope Pot Firemen, non-mechanical; Driller Tender (when required to move and position machine); Form Setter, Paving; Grade Checker using level; Hazardous Waste Worker, Level C (uses a chemical "splash suit" and air purifying respirator); Jackhammer Operator; Miner, Class "B" (to include brakeman, finisher, vibrator, form setter); Nozzleman (to include squeeze and flo-crete nozzle); Nozzleman, water, air or steam; Pavement Breaker (under 90 lbs.); Pipelayer, corrugated metal culvert; Pipelayer, multi- plate; Pot Tender; Power Buggy Operator; Power Tool Operator, gas, electric, pneumatic; Railroad Equipment, power driven, except dual mobile power spiker or puller; Railroad Power Spiker or Puller, dual mobile; Rodder and Spreader; Tamper (to include operation of Barco, Essex and similar tampers); Trencher, Shawnee; Tugger Operator; Wagon Drills; Water Pipe Liner; Wheelbarrow (power driven)

GROUP 4: Air and Hydraulic Track Drill; Aspahlt Raker;Brush Machine (to include horizontal construction joint cleanup brush machine, power propelled); Caisson Worker, free air; Chain Saw Operator and Faller; Concrete Stack (to include laborers when laborers working on free standing concrete stacks for smoke or fume control above 40 feet high); Gunite (to include operation of machine and nozzle); Hazardous Waste Worker, Level B (uses same respirator protection as Level A. A supplied air line is provided in conjunction with a chemical "splash suit"); High Scaler; Laser Beam Operator (to include grade checker and elevation control); Miner, Class C (to include miner, nozzleman for concrete, laser beam operator and rigger on tunnels); Monitor Operator (air track or similar mounting); Mortar Mixer; Nozzleman (to include jet blasting nozzleman, over 1,200 lbs., jet blast machine power propelled, sandblast nozzle); Pavement Breaker (90 lbs. and over); Pipelayer (to include working topman, caulker, collarman, jointer, mortarman, rigger, jacker, shorer, valve or meter installer); Pipewrapper; Plasterer Tender; Vibrators (all)

GROUP 5 - Drills with Dual Masts; Hazardous Waste Worker, Level A (utilizes a fully encapsulated suit with a self-contained breathing apparatus or a supplied air line); Miner Class "D", (to include raise and shaft miner, laser beam operator on riases and shafts)

LABO0238-006 06/01/2017

COUNTIES EAST OF THE 120TH MERIDIAN: ADAMS, ASOTIN, BENTON, CHELAN, COLUMBIA, DOUGLAS, FERRY, FRANKLIN, GARFIELD, GRANT, LINCOLN, OKANOGAN, PEND OREILLE, STEVENS, SPOKANE, WALLA WALLA, WHITMAN

	Rates	Fringes
Hod Carrier	$ 26.76	11.30

LABO0252-010 06/01/2017

CLALLAM, GRAYS HARBOR, JEFFERSON, KITSAP, LEWIS, MASON, PACIFIC (EXCLUDING SOUTHWEST), PIERCE, AND THURSTON COUNTIES

	Rates	Fringes
LABORER		
GROUP 1	$ 24.85	10.99
GROUP 2	$ 28.45	10.99
GROUP 3	$ 35.54	10.99
GROUP 4	$ 36.41	10.99
GROUP 5	$ 36.99	10.99

BASE POINTS: BELLINGHAM, MT. VERNON, EVERETT, SEATTLE, KENT, TACOMA, OLYMPIA, CENTRALIA, ABERDEEN, SHELTON, PT. TOWNSEND, PT. ANGELES, AND BREMERTON

ZONE 1 - Projects within 25 radius miles of the respective city hall
ZONE 2 - More than 25 but less than 45 radius miles from the respective city hall
ZONE 3 - More than 45 radius miles from the respective city hall

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):
ZONE 2 - $1.00
ZONE 3 - $1.30

BASE POINTS: CHELAN, SUNNYSIDE, WENATCHEE, AND YAKIMA

ZONE 1 - Projects within 25 radius miles of the respective city hall
ZONE 2 - More than 25 radius miles from the respective city hall

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):
ZONE 2 - $2.25

LABORERS CLASSIFICATIONS

GROUP 1: Landscaping and Planting; Watchman; Window Washer/Cleaner (detail clean-up, such as but not limited to cleaning floors, ceilings, walls, windows, etc., prior to final acceptance by the owner)

GROUP 2: Batch Weighman; Crusher Feeder; Fence Laborer; Flagman; Pilot Car

GROUP 3: General Laborer; Air, Gas, or Electric Vibrating Screed; Asbestos Abatement Laborer; Ballast Regulator Machine; Brush Cutter; Brush Hog Feeder; Burner; Carpenter Tender; Cement Finisher Tender; Change House or Dry Shack; Chipping Gun (under 30 lbs.); Choker Setter; Chuck Tender; Clean-up Laborer; Concrete Form Stripper; Curing Laborer; Demolition (wrecking and moving including charred material); Ditch Digger; Dump Person; Fine Graders; Firewatch; Form Setter; Gabian Basket Builders; Grout Machine Tender; Grinders; Guardrail Erector; Hazardous Waste Worker (Level C: uses a chemical "splash suit" and air purifying respirator); Maintenance Person; Material Yard Person; Pot Tender; Rip Rap Person; Riggers; Scale Person; Sloper Sprayer; Signal Person; Stock Piler; Stake Hopper; Toolroom Man (at job site); Topper-Tailer; Track Laborer; Truck Spotter; Vinyl Seamer

GROUP 4: Cement Dumper-Paving; Chipping Gun (over 30 lbs.); Clary Power Spreader; Concrete Dumper/Chute Operator; Concrete Saw Operator; Drill Operator (hydraulic, diamond, aiartrac); Faller and Bucker Chain Saw; Grade Checker and Transit Person; Groutmen (pressure) including post tension beams; Hazardous Waste Worker (Level B: uses same respirator protection as Level A. A supplied air line is provided in conjunction with a chemical "splash suit"); High Scaler; Jackhammer; Laserbeam Operator; Manhole Builder-Mudman; Nozzleman (concrete pump, green cutter when using combination of high pressure air and water on concrete and rock, sandblast, gunite, shotcrete, water blaster, vacuum blaster); Pavement Breaker; Pipe Layer and Caulker; Pipe Pot Tender; Pipe Reliner (not insert type); Pipe Wrapper; Power Jacks; Railroad Spike Puller-Power; Raker-Asphalt; Rivet Buster; Rodder; Sloper (over 20 ft); Spreader (concrete); Tamper and Similar electric, air and glas operated tool; Timber Person-sewer (lagger shorer and cribber); Track Liner Power; Tugger Operator; Vibrator; Well Point Laborer

GROUP 5: Caisson Worker; Miner; Mortarman and Hodcarrier; Powderman; Re-Timberman; Hazardous Waste Worker (Level A: utilizes a fully encapsulated suit with a self-contained breathing apparatus or a supplied air line).

LABO0292-008 06/01/2017

ISLAND, SAN JUAN, SKAGIT, SNOHOMISH, AND WHATCOM COUNTIES

	Rates	Fringes
LABORER		
GROUP 1	$ 24.85	10.99
GROUP 2	$ 28.45	10.99
GROUP 3	$ 35.54	10.99
GROUP 4	$ 36.41	10.99
GROUP 5	$ 36.99	10.99

BASE POINTS: BELLINGHAM, MT. VERNON, EVERETT, SEATTLE, KENT, TACOMA, OLYMPIA, CENTRALIA, ABERDEEN, SHELTON, PT. TOWNSEND, PT. ANGELES, AND BREMERTON

ZONE 1 - Projects within 25 radius miles of the respective city hall
ZONE 2 - More than 25 but less than 45 radius miles from the respective city hall
ZONE 3 - More than 45 radius miles from the respective city hall

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):
ZONE 2 - $1.00
ZONE 3 - $1.30

BASE POINTS: CHELAN, SUNNYSIDE, WENATCHEE, AND YAKIMA

ZONE 1 - Projects within 25 radius miles of the respective city hall
ZONE 2 - More than 25 radius miles from the respective city hall

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):
ZONE 2 - $2.25

LABORERS CLASSIFICATIONS

GROUP 1: Landscaping and Planting; Watchman; Window Washer/Cleaner (detail clean-up, such as but not limited to cleaning floors, ceilings, walls, windows, etc., prior to final acceptance by the owner)

GROUP 2: Batch Weighman; Crusher Feeder; Fence Laborer; Flagman; Pilot Car

GROUP 3: General Laborer; Air, Gas, or Electric Vibrating Screed; Asbestos Abatement Laborer; Ballast Regulator Machine; Brush Cutter; Brush Hog Feeder; Burner; Carpenter Tender; Cement Finisher Tender; Change House or Dry Shack; Chipping Gun (under 30 lbs.); Choker Setter; Chuck Tender; Clean-up Laborer; Concrete Form Stripper; Curing Laborer; Demolition (wrecking and moving including charred material); Ditch Digger; Dump Person; Fine Graders; Firewatch; Form Setter; Gabian Basket Builders; Grout Machine Tender; Grinders; Guardrail Erector; Hazardous Waste Worker (Level C: uses a chemical "splash suit" and air purifying respirator); Maintenance Person; Material Yard Person; Pot Tender; Rip Rap Person; Riggers; Scale Person; Sloper Sprayer; Signal Person; Stock Piler; Stake Hopper; Toolroom Man (at job site); Topper-Tailer; Track Laborer; Truck Spotter; Vinyl Seamer

GROUP 4: Cement Dumper-Paving; Chipping Gun (over 30 lbs.); Clary Power Spreader; Concrete Dumper/Chute Operator; Concrete Saw Operator; Drill Operator (hydraulic, diamond, aiartrac); Faller and Bucker Chain Saw; Grade Checker and Transit Person; Groutmen (pressure) including post tension beams; Hazardous Waste Worker (Level B: uses same respirator protection as Level A. A supplied air line is provided in conjunction with a chemical "splash suit"); High Scaler; Jackhammer; Laserbeam Operator; Manhole Builder-Mudman; Nozzleman (concrete pump, green cutter when using combination of high pressure air and water on concrete and rock, sandblast, gunite, shotcrete, water blaster, vacuum blaster); Pavement Breaker; Pipe Layer and Caulker; Pipe Pot Tender; Pipe Reliner (not insert type); Pipe Wrapper; Power Jacks; Railroad Spike Puller-Power; Raker-Asphalt; Rivet Buster; Rodder; Sloper (over 20 ft); Spreader (concrete); Tamper and Similar electric, air and glas operated tool; Timber Person-sewer (lagger shorer and cribber); Track Liner Power; Tugger Operator; Vibrator; Well Point Laborer

GROUP 5: Caisson Worker; Miner; Mortarman and Hodcarrier; Powderman; Re-Timberman; Hazardous Waste Worker (Level A: utilizes a fully encapsulated suit with a self-contained breathing apparatus or a supplied air line).

LABO0335-001 06/01/2017

CLARK, COWLITZ, KLICKITAT, PACIFIC (SOUTH OF A STRAIGHT LINE MADE BY EXTENDING THE NORTH BOUNDARY LINE OF WAHKIAKUM COUNTY WEST TO THE PACIFIC OCEAN), SKAMANIA AND WAHKIAKUM COUNTIES

	Rates	Fringes
Laborers:		
ZONE 1:		
GROUP 1	$ 31.36	10.89
GROUP 2	$ 32.01	10.89
GROUP 3	$ 32.49	10.89
GROUP 4	$ 32.90	10.89
GROUP 5	$ 28.68	10.89
GROUP 6	$ 26.07	10.89
GROUP 7	$ 22.62	10.89

Zone Differential (Add to Zone 1 rates):
Zone 2 $ 0.65
Zone 3 - 1.15
Zone 4 - 1.70
Zone 5 - 2.75

BASE POINTS: LONGVIEW AND VANCOUVER

ZONE 1: Projects within 30 miles of the respective city all.
ZONE 2: More than 30 miles but less than 40 miles from the respective city hall.
ZONE 3: More than 40 miles but less than 50 miles from the respective city hall.
ZONE 4: More than 50 miles but less than 80 miles from the respective city hall.
ZONE 5: More than 80 miles from the respective city hall.

LABORERS CLASSIFICATIONS

GROUP 1: Asphalt Plant Laborers; Asphalt Spreaders; Batch Weighman; Broomers; Brush Burners and Cutters; Car and Truck Loaders; Carpenter Tender; Change-House Man or Dry Shack Man; Choker Setter; Clean-up Laborers; Curing, Concrete; Demolition, Wrecking and Moving Laborers; Dumpers, road oiling crew; Dumpmen (for grading crew); Elevator Feeders; Median Rail Reference Post, Guide Post, Right of Way Marker; Fine Graders; Fire Watch; Form Strippers (not swinging stages); General Laborers; Hazardous Waste Worker; Leverman or Aggregate Spreader (Flaherty and similar types); Loading Spotters; Material Yard Man (including electrical); Pittsburgh Chipper Operator or Similar Types; Railroad Track Laborers; Ribbon Setters (including steel forms); Rip Rap Man (hand placed); Road Pump Tender; Sewer Labor; Signalman; Skipman; Slopers; Spraymen; Stake Chaser; Stockpiler; Tie Back Shoring; Timber Faller and Bucker (hand labor); Toolroom Man (at job site); Tunnel Bullgang (above ground); Weight-Man- Crusher (aggregate when used)

GROUP 2: Applicator (including pot power tender for same), applying protective material by hand or nozzle on utility lines or storage tanks on project; Brush Cutters (power saw); Burners; Choker Splicer; Clary Power Spreader and similar types; Clean- up Nozzleman-Green Cutter (concrete, rock, etc.); Concrete Power Buggyman; Concrete Laborer; Crusher Feeder; Demolition and Wrecking Charred Materials; Gunite Nozzleman Tender; Gunite or Sand Blasting Pot Tender; Handlers or Mixers of all Materials of an irritating nature (including cement and lime); Tool Operators (includes but not limited to: Dry Pack Machine; Jackhammer; Chipping Guns; Paving Breakers); Pipe Doping and Wrapping; Post Hole Digger, air, gas or electric; Vibrating Screed; Tampers; Sand Blasting (Wet); Stake-Setter; Tunnel-Muckers, Brakemen, Concrete Crew, Bullgang (underground)

GROUP 3: Asbestos Removal; Bit Grinder; Drill Doctor; Drill Operators, air tracks, cat drills, wagon drills, rubber-mounted drills, and other similar types including at crusher plants; Gunite Nozzleman; High Scalers, Strippers and Drillers (covers work in swinging stages, chairs or belts, under extreme conditions unusual to normal drilling, blasting, barring-down, or sloping and stripping); Manhole Builder; Powdermen; Concrete Saw Operator; Pwdermen; Power Saw Operators (Bucking and Falling); Pumpcrete Nozzlemen; Sand Blasting (Dry); Sewer Timberman; Track Liners, Anchor Machines, Ballast Regulators, Multiple Tampers, Power Jacks, Tugger Operator; Tunnel-Chuck Tenders, Nippers and Timbermen; Vibrator; Water Blaster

GROUP 4: Asphalt Raker; Concrete Saw Operator (walls); Concrete Nozzelman; Grade Checker; Pipelayer; Laser Beam (pipelaying)-applicable when employee assigned to move, set up, align; Laser Beam; Tunnel Miners; Motorman-Dinky Locomotive-Tunnel; Powderman-Tunnel; Shield Operator-Tunnel

GROUP 5: Traffic Flaggers

GROUP 6: Fence Builders

GROUP 7: Landscaping or Planting Laborers

LABO0335-019 09/01/2013

	Rates	Fringes
Hod Carrier.....	$ 30.47	10.05

LABO0348-003 06/01/2017

CHELAN, DOUGLAS (W OF 12TH MERIDIAN), KITTITAS, AND YAKIMA COUNTIES

	Rates	Fringes
LABORER		
GROUP 1	$ 21.21	10.99
GROUP 2	$ 24.31	10.99
GROUP 3	$ 26.60	10.99
GROUP 4	$ 27.24	10.99
GROUP 5	$ 27.70	10.99

BASE POINTS: BELLINGHAM, MT. VERNON, EVERETT, SEATTLE, KENT, TACOMA, OLYMPIA, CENTRALIA, ABERDEEN, SHELTON, PT. TOWNSEND, PT. ANGELES, AND BREMERTON

ZONE 1 - Projects within 25 radius miles of the respective city hall
ZONE 2 - More than 25 but less than 45 radius miles from the respective city hall
ZONE 3 - More than 45 radius miles from the respective city hall

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):
ZONE 2 - $1.00
ZONE 3 - $1.30

BASE POINTS: CHELAN, SUNNYSIDE, WENATCHEE, AND YAKIMA

ZONE 1 - Projects within 25 radius miles of the respective city hall
ZONE 2 - More than 25 radius miles from the respective city hall

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):
ZONE 2 - $2.25

LABORERS CLASSIFICATIONS

GROUP 1: Landscaping and Planting; Watchman; Window Washer/Cleaner (detail clean-up, such as but not limited to cleaning floors, ceilings, walls, windows, etc., prior to final acceptance by the owner)

GROUP 2: Batch Weighman; Crusher Feeder; Fence Laborer; Flagman; Pilot Car

GROUP 3: General Laborer; Air, Gas, or Electric Vibrating Screed; Asbestos Abatement Laborer; Ballast Regulator Machine; Brush Cutter; Brush Hog Feeder; Burner; Carpenter Tender; Cement Finisher Tender; Change House or Dry Shack; Chipping Gun (under 30 lbs.); Choker Setter; Chuck Tender; Clean-up Laborer; Concrete Form Stripper; Curing Laborer; Demolition (wrecking and moving including charred material); Ditch Digger; Dump Person; Fine Graders; Firewatch; Form Setter; Gabian Basket Builders; Grout Machine Tender; Grinders; Guardrail Erector; Hazardous Waste Worker (Level C: uses a chemical "splash suit" and air purifying respirator); Maintenance Person; Material Yard Person; Pot Tender; Rip Rap Person; Riggers; Scale Person; Sloper Sprayer; Signal Person; Stock Piler; Stake Hopper; Toolroom Man (at job site); Topper-Tailer; Track Laborer; Truck Spotter; Vinyl Seamer

GROUP 4: Cement Dumper-Paving; Chipping Gun (over 30 lbs.); Clary Power Spreader; Concrete Dumper/Chute Operator; Concrete Saw Operator; Drill Operator (hydraulic, diamond, aiartrac); Faller and Bucker Chain Saw; Grade Checker and Transit Person; Groutmen (pressure) including post tension beams; Hazardous Waste Worker (Level B: uses same respirator protection as Level A. A supplied air line is provided in conjunction with a chemical "splash suit"); High Scaler; Jackhammer; Laserbeam Operator; Manhole Builder-Mudman; Nozzleman (concrete pump, green cutter when using combination of high pressure air and water on concrete and rock, sandblast, gunite, shotcrete, water blaster, vacuum blaster); Pavement Breaker; Pipe Layer and Caulker; Pipe Pot Tender; Pipe Reliner (not insert type); Pipe Wrapper; Power Jacks; Railroad Spike Puller-Power; Raker-Asphalt; Rivet Buster; Rodder; Sloper (over 20 ft); Spreader (concrete); Tamper and Similar electric, air and glas operated tool; Timber Person-sewer (lagger shorer and cribber); Track Liner Power; Tugger Operator; Vibrator; Well Point Laborer

GROUP 5: Caisson Worker; Miner; Mortarman and Hodcarrier; Powderman; Re-Timberman; Hazardous Waste Worker (Level A: utilizes a fully encapsulated suit with a self-contained breathing apparatus or a supplied air line).

LABO0440-001 06/01/2017

KING COUNTY

	Rates	Fringes
LABORER		
GROUP 1	$ 24.85	10.99
GROUP 2	$ 28.45	10.99
GROUP 3	$ 35.54	10.99
GROUP 4	$ 36.41	10.99
GROUP 5	$ 36.99	10.99

BASE POINTS: BELLINGHAM, MT. VERNON, EVERETT, SEATTLE, KENT, TACOMA, OLYMPIA, CENTRALIA, ABERDEEN, SHELTON, PT. TOWNSEND, PT. ANGELES, AND BREMERTON

ZONE 1 - Projects within 25 radius miles of the respective city hall
ZONE 2 - More than 25 but less than 45 radius miles from the respective city hall
ZONE 3 - More than 45 radius miles from the respective city hall

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):
ZONE 2 - $1.00
ZONE 3 - $1.30

BASE POINTS: CHELAN, SUNNYSIDE, WENATCHEE, AND YAKIMA

ZONE 1 - Projects within 25 radius miles of the respective city hall
ZONE 2 - More than 25 radius miles from the respective city hall

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):
ZONE 2 - $2.25

LABORERS CLASSIFICATIONS

GROUP 1: Landscaping and Planting; Watchman; Window Washer/Cleaner (detail clean-up, such as but not limited to cleaning floors, ceilings, walls, windows, etc., prior to final acceptance by the owner)

GROUP 2: Batch Weighman; Crusher Feeder; Fence Laborer; Flagman; Pilot Car

GROUP 3: General Laborer; Air, Gas, or Electric Vibrating Screed; Asbestos Abatement Laborer; Ballast Regulator Machine; Brush Cutter; Brush Hog Feeder; Burner; Carpenter Tender; Cement Finisher Tender; Change House or Dry Shack; Chipping Gun (under 30 lbs.); Choker Setter; Chuck Tender; Clean-up Laborer; Concrete Form Stripper; Curing Laborer; Demolition (wrecking and moving including charred material); Ditch Digger; Dump Person; Fine Graders; Firewatch; Form Setter; Gabian Basket Builders; Grout

Machine Tender; Grinders; Guardrail Erector; Hazardous Waste Worker (Level C: uses a chemical "splash suit" and air purifying respirator); Maintenance Person; Material Yard Person; Pot Tender; Rip Rap Person; Riggers; Scale Person; Sloper Sprayer; Signal Person; Stock Piler; Stake Hopper; Toolroom Man (at job site); Topper-Tailer; Track Laborer; Truck Spotter; Vinyl Seamer

GROUP 4: Cement Dumper-Paving; Chipping Gun (over 30 lbs.); Clary Power Spreader; Concrete Dumper/Chute Operator; Concrete Saw Operator; Drill Operator (hydraulic, diamond, aiartrac); Faller and Bucker Chain Saw; Grade Checker and Transit Person; Groutmen (pressure) including post tension beams; Hazardous Waste Worker (Level B: uses same respirator protection as Level A. A supplied air line is provided in conjunction with a chemical "splash suit"); High Scaler; Jackhammer; Laserbeam Operator; Manhole Builder-Mudman; Nozzleman (concrete pump, green cutter when using combination of high pressure air and water on concrete and rock, sandblast, gunite, shotcrete, water blaster, vacuum blaster); Pavement Breaker; Pipe Layer and Caulker; Pipe Pot Tender; Pipe Reliner (not insert type); Pipe Wrapper; Power Jacks; Railroad Spike Puller-Power; Raker-Asphalt; Rivet Buster; Rodder; Sloper (over 20 ft); Spreader (concrete); Tamper and Similar electric, air and glas operated tool; Timber Person-sewer (lagger shorer and cribber); Track Liner Power; Tugger Operator; Vibrator; Well Point Laborer

GROUP 5: Caisson Worker; Miner; Mortarman and Hodcarrier; Powderman; Re-Timberman; Hazardous Waste Worker (Level A: utilizes a fully encapsulated suit with a self-contained breathing apparatus or a supplied air line).

PAIN0005-002 07/01/2017

STATEWIDE EXCEPT CLARK, COWLITZ, KLICKITAT, PACIFIC (SOUTH), SKAMANIA, AND WAHKIAKUM COUNTIES

	Rates	Fringes
Painters:		
STRIPERS	$ 29.50	15.43

PAIN0005-004 03/01/2009

CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP, LEWIS, MASON, PIERCE, SAN JUAN, SKAGIT, SNOHOMISH, THURSTON AND WHATCOM COUNTIES

	Rates	Fringes
PAINTER	$ 20.82	7.44

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* PAIN0005-006 07/01/2017

ADAMS, ASOTIN; BENTON AND FRANKLIN (EXCEPT HANFORD SITE);
CHELAN, COLUMBIA, DOUGLAS, FERRY, GARFIELD, GRANT, KITTITAS,
LINCOLN, OKANOGAN, PEND OREILLE, SPOKANE, STEVENS, WALLA WALLA,
WHITMAN AND YAKIMA COUNTIES

	Rates	Fringes
PAINTER		
Application of Cold Tar Products, Epoxies, Polyure thanes, Acids, Radiation Resistant Material, Water and Sandblasting	$ 30.29	11.10
Over 30'/Swing Stage Work	$ 22.20	7.98
Brush, Roller, Striping, Steam-cleaning and Spray	$ 25.19	11.10
Lead Abatement, Asbestos Abatement	$ 21.50	7.98

*$.70 shall be paid over and above the basic wage rates listed for work on swing stages and high work of over 30 feet.

PAIN0055-003 07/01/2017

CLARK, COWLITZ, KLICKITAT, PACIFIC, SKAMANIA, AND WAHKIAKUM
COUNTIES

	Rates	Fringes
PAINTER		
Brush & Roller	$ 23.02	11.02
High work - All work 60 ft. or higher	$ 23.77	11.02
Spray and Sandblasting	$ 23.02	11.02

PAIN0055-006 07/01/2017

CLARK, COWLITZ, KLICKITAT, SKAMANIA and WAHKIAKUM COUNTIES

	Rates	Fringes
Painters:		
HIGHWAY & PARKING LOT STRIPER	$ 34.87	11.46

PLAS0072-004 06/01/2017

ADAMS, ASOTIN, BENTON, CHELAN, COLUMBIA, DOUGLAS, FERRY, FRANKLIN, GARFIELD, GRANT, KITTITAS, LINCOLN, OKANOGAN, PEND OREILLE, SPOKANE, STEVENS, WALLA WALLA, WHITMAN, AND YAKIMA COUNTIES

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER		
ZONE 1	$ 28.23	13.77

Zone Differential (Add to Zone 1 rate): Zone 2 - $2.00

BASE POINTS: Spokane, Pasco, Lewiston; Wenatchee
Zone 1: 0 - 45 radius miles from the main post office
Zone 2: Over 45 radius miles from the main post office

PLAS0528-001 06/01/2017

CLALLAM, COWLITZ, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP, LEWIS, MASON, PACIFIC, PIERCE, SAN JUAN, SKAGIT, SNOHOMISH, THURSTON, WAHKIAKUM AND WHATCOM COUNTIES

	Rates	Fringes
CEMENT MASON		
CEMENT MASON	$ 40.52	16.54
COMPOSITION, TROWEL MACHINE, GRINDER, POWER TOOLS, GUNNITE NOZZLE	$ 41.02	16.54
TROWLING MACHINE OPERATOR ON COMPOSITION	$ 41.02	16.54

PLAS0555-002 06/01/2017

CLARK, KLICKITAT AND SKAMANIA COUNTIES

ZONE 1:

	Rates	Fringes
CEMENT MASON		
CEMENT MASONS DOING BOTH COMPOSITION/POWER MACHINERY AND SUSPENDED/HANGING SCAFFOLD	$ 32.87	17.62
CEMENT MASONS ON SUSPENDED, SWINGING AND/OR HANGING SCAFFOLD	$ 32.87	17.62
CEMENT MASONS	$ 31.50	17.62
COMPOSITION WORKERS AND POWER MACHINERY OPERATORS	$ 32.19	17.62

Zone Differential (Add To Zone 1 Rates):
Zone 2 - $0.65
Zone 3 - 1.15
Zone 4 - 1.70
Zone 5 - 3.00

BASE POINTS: BEND, CORVALLIS, EUGENE, MEDFORD, PORTLAND, SALEM, THE DALLES, VANCOUVER

ZONE 1: Projects within 30 miles of the respective city hall
ZONE 2: More than 30 miles but less than 40 miles from the respective city hall.
ZONE 3: More than 40 miles but less than 50 miles from the respective city hall.
ZONE 4: More than 50 miles but less than 80 miles from the respective city hall.
ZONE 5: More than 80 miles from the respective city hall

TEAM0037-002 06/01/2017

CLARK, COWLITZ, KLICKITAT, PACIFIC (South of a straight line made by extending the north boundary line of Wahkiakum County west to the Pacific Ocean), SKAMANIA, AND WAHKIAKUM COUNTIES

	Rates	Fringes
Truck drivers:		
ZONE 1		
GROUP 1	$ 27.94	14.37
GROUP 2	$ 28.06	14.37
GROUP 3	$ 28.19	14.37
GROUP 4	$ 28.46	14.37
GROUP 5	$ 28.68	14.37
GROUP 6	$ 28.85	14.37
GROUP 7	$ 29.05	14.37

Zone Differential (Add to Zone 1 Rates):
Zone 2 - $0.65
Zone 3 - 1.15
Zone 4 - 1.70
Zone 5 - 2.75

BASE POINTS: ASTORIA, THE DALLES, LONGVIEW AND VANCOUVER

ZONE 1: Projects within 30 miles of the respective city hall.
ZONE 2: More than 30 miles but less than 40 miles from the respective city hall.
ZONE 3: More than 40 miles but less than 50 miles from the respective city hall.
ZONE 4: More than 50 miles but less than 80 miles from the respective city hall.
ZONE 5: More than 80 miles from the respective city hall.

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1: A Frame or Hydra lifrt truck w/load bearing surface; Articulated Dump Truck; Battery Rebuilders; Bus or Manhaul Driver; Concrete Buggies (power operated); Concrete Pump Truck; Dump Trucks, side, end and bottom dumps, including Semi Trucks and Trains or combinations there of: up to and including 10 cu. yds.; Lift Jitneys, Fork Lifts (all sizes in loading, unloading and transporting material on job site); Loader and/or Leverman on Concrete Dry Batch Plant (manually operated); Pilot Car; Pickup Truck; Solo Flat Bed and misc. Body Trucks, 0-10 tons; Truck Tender; Truck Mechanic Tender; Water Wagons (rated capacity) up to 3,000 gallons; Transit Mix and Wet or Dry Mix - 5 cu. yds. and under; Lubrication Man, Fuel Truck Driver, Tireman, Wash Rack, Steam Cleaner or combinations; Team Driver; Slurry Truck Driver or Leverman; Tireman

GROUP 2: Boom Truck/Hydra-lift or Retracting Crane; Challenger; Dumpsters or similar equipment all sizes; Dump Trucks/Articulated Dumps 6 cu to 10 cu.; Flaherty Spreader Driver or Leverman; Lowbed Equipment, Flat Bed Semi-trailer or doubles transporting equipment or wet or dry materials; Lumber Carrier, Driver-Straddle Carrier (used in loading, unloading and transporting of materials on job site); Oil Distributor Driver or Leverman; Transit mix and wet or dry mix trcuks: over 5 cu. yds. and including 7 cu. yds.; Vacuum Trucks; Water truck/Wagons (rated capacity) over 3,000 to 5,000 gallons

GROUP 3: Ammonia Nitrate Distributor Driver; Dump trucks, side, end and bottom dumps, including Semi Trucks and Trains or combinations thereof: over 10 cu. yds. and including 30 cu. yds. includes Articulated Dump Trucks; Self-Propelled Street Sweeper; Transit mix and wet or dry mix truck: over 7 cu yds. and including 11 cu yds.; Truck Mechanic-Welder-Body Repairman; Utility and Clean-up Truck; Water Wagons (rated capacity) over 5,000 to 10,000 gallons

GROUP 4: Asphalt Burner; Dump Trucks, side, end and bottom cumps, including Semi-Trucks and Trains or combinations thereof: over 30 cu. yds. and including 50 cu. yds. includes Articulated Dump Trucks; Fire Guard; Transit Mix and Wet or Dry Mix Trucks, over 11 cu. yds. and including 15 cu. yds.; Water Wagon (rated capacity) over 10,000 gallons to 15,000 gallons

GROUP 5: Composite Crewman; Dump Trucks, side, end and bottom dumps, including Semi Trucks and Trains or combinations thereof: over 50 cu. yds. and including 60 cu. yds. includes Articulated Dump Trucks

GROUP 6: Bulk Cement Spreader w/o Auger; Dry Pre-Batch concrete Mix Trucks; Dump trucks, side, end and bottom dumps, including Semi Trucks and Trains of combinations thereof: over 60 cu. yds. and including 80 cu. yds., and includes Articulated Dump Trucks; Skid Truck

GROUP 7: Dump Trucks, side, end and bottom dumps, including Semi Trucks and Trains or combinations thereof: over 80 cu. yds. and including 100 cu. yds., includes Articulated Dump Trucks; Industrial Lift Truck (mechanical tailgate)

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CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP, LEWIS, MASON, PACIFIC (North of a straight line made by extending the north boundary line of Wahkiakum County west to the Pacific Ocean), PIERCE, SAN JUAN, SKAGIT, SNOHOMISH, THURSTON AND WHATCOM COUNTIES

	Rates	Fringes
Truck drivers:		
ZONE A:		
GROUP 1:	$ 34.13	18.57
GROUP 2:	$ 33.29	18.57
GROUP 3:	$ 30.48	18.57
GROUP 4:	$ 25.51	18.57
GROUP 5:	$ 33.68	18.57

ZONE B (25-45 miles from center of listed cities*): Add $.70 per hour to Zone A rates.
ZONE C (over 45 miles from centr of listed cities*): Add $1.00 per hour to Zone A rates.

*Zone pay will be calculated from the city center of the following listed cities:

BELLINGHAM	CENTRALIA	RAYMOND	OLYMPIA
EVERETT	SHELTON	ANACORTES	BELLEVUE
SEATTLE	PORT ANGELES	MT. VERNON	KENT
TACOMA	PORT TOWNSEND	ABERDEEN	BREMERTON

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1 - "A-frame or Hydralift" trucks and Boom trucks or similar equipment when "A" frame or "Hydralift" and Boom truck or similar equipment is used; Buggymobile; Bulk Cement Tanker; Dumpsters and similar equipment, Tournorockers, Tournowagon, Tournotrailer, Cat DW series, Terra Cobra, Le Tourneau, Westinghouse, Athye Wagon, Euclid Two and Four-Wheeled power tractor with trailer and similar top-loaded equipment transporting material: Dump Trucks, side, end and bottom dump, including semi-trucks and trains or combinations thereof with 16 yards to 30 yards capacity: Over 30 yards $.15 per hour additional for each 10 yard increment; Explosive Truck (field mix) and similar equipment; Hyster Operators (handling bulk loose aggregates); Lowbed and Heavy Duty Trailer; Road Oil Distributor Driver; Spreader, Flaherty Transit mix used exclusively in heavy construction; Water Wagon and Tank Truck-3,000 gallons and over capacity

GROUP 2 - Bulllifts, or similar equipment used in loading or unloading trucks, transporting materials on job site; Dumpsters, and similar equipment, Tournorockers, Tournowagon, Turnotrailer, Cat. D.W. Series, Terra Cobra, Le Tourneau, Westinghouse, Athye wagon, Euclid two and four-wheeled power tractor with trailer and similar top-loaded equipment transporting material: Dump trucks, side, end and bottom dump, including semi-trucks and trains or combinations thereof with less than 16 yards capacity; Flatbed (Dual Rear Axle); Grease Truck, Fuel Truck, Greaser, Battery Service Man and/or Tire Service Man; Leverman and loader at bunkers and batch plants; Oil tank transport; Scissor truck; Slurry Truck; Sno-Go and similar equipment; Swampers; Straddler Carrier (Ross, Hyster) and similar equipment; Team Driver; Tractor (small, rubber-tired)(when used within Teamster jurisdiction); Vacuum truck; Water Wagon and Tank trucks-less than 3,000 gallons capacity; Winch Truck; Wrecker, Tow truck and similar equipment

GROUP 3 - Flatbed (single rear axle); Pickup Sweeper; Pickup Truck. (Adjust Group 3 upward by $2.00 per hour for onsite work only)

GROUP 4 - Escort or Pilot Car

GROUP 5 - Mechanic

HAZMAT PROJECTS

Anyone working on a HAZMAT job, where HAZMAT certification is required, shall be compensated as a premium, in addition to the classification working in as follows:
LEVEL C: +$.25 per hour - This level uses an air purifying respirator or additional protective clothing.
LEVEL B: +$.50 per hour - Uses same respirator protection as Level A. Supplied air line is provided in conjunction with a chemical "splash suit."
LEVEL A: +$.75 per hour - This level utilizes a fully-encapsulated suit with a self-contained breathing apparatus or a supplied air line.

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ADAMS, ASOTIN, BENTON, CHELAN, COLUMBIA, DOUGLAS, FERRY, FRANKLIN, GARFIELD, GRANT KITTITAS, LINCOLN, OKANOGAN, PEND OREILLE, SPOKANE, STEVENS, WALLA WALLA, WHITMAN AND YAKIMA COUNTIES

	Rates	Fringes
Truck drivers: (AREA 1: SPOKANE ZONE CENTER: Adams, Chelan, Douglas, Ferry, Grant, Kittitas, Lincoln, Okanogan, Pen Oreille, Spokane, Stevens, and Whitman Counties		
AREA 1: LEWISTON ZONE CENTER: Asotin, Columbia, and Garfield Counties		
AREA 2: PASCO ZONE CENTER: Benton, Franklin, Walla Walla and Yakima Counties)		
AREA 1:		
GROUP 1	$ 21.82	17.30
GROUP 2	$ 24.09	17.30
GROUP 3	$ 24.59	17.30
GROUP 4	$ 24.92	17.30
GROUP 5	$ 25.03	17.30
GROUP 6	$ 25.20	17.30
GROUP 7	$ 25.73	17.30
GROUP 8	$ 26.09	17.30
AREA 2:		
GROUP 1	$ 23.96	17.30
GROUP 2	$ 26.20	17.30
GROUP 3	$ 26.71	17.30
GROUP 4	$ 27.04	17.30
GROUP 5	$ 27.15	17.30
GROUP 6	$ 27.15	17.30
GROUP 7	$ 28.05	17.30
GROUP 8	$ 28.01	17.30

Zone Differential (Add to Zone 1 rate: Zone 1 + $2.00)

BASE POINTS: Spokane, Pasco, Lewiston
Zone 1: 0-45 radius miles from the main post office.
Zone 2: Outside 45 radius miles from the main post office

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1: Escort Driver or Pilot Car; Employee Haul; Power Boat Hauling Employees or Material

GROUP 2: Fish Truck; Flat Bed Truck; Fork Lift (3000 lbs. and under); Leverperson (loading trucks at bunkers); Trailer Mounted Hydro Seeder and Mulcher; Seeder & Mulcher; Stationary Fuel Operator; Tractor (small, rubber-tired, pulling trailer or similar equipment)

GROUP 3: Auto Crane (2000 lbs. capacity); Buggy Mobile & Similar; Bulk Cement Tanks & Spreader; Dumptor (6 yds. & under); Flat Bed Truck with Hydraullic System; Fork Lift (3001-16,000 lbs.); Fuel Truck Driver, Steamcleaner & Washer; Power Operated Sweeper; Rubber-tired Tunnel Jumbo; Scissors Truck; Slurry Truck Driver; Straddle Carrier (Ross, Hyster, & similar); Tireperson; Transit Mixers & Truck Hauling Concrete (3 yd. to & including 6 yds.); Trucks, side, end, bottom & articulated end dump (3 yards to and including 6 yds.); Warehouseperson (to include shipping & receiving); Wrecker & Tow Truck

GROUP 4: A-Frame; Burner, Cutter, & Welder; Service Greaser; Trucks, side, end, bottom & articulated end dump (over 6 yards to and including 12 yds.); Truck Mounted Hydro Seeder; Warehouseperson; Water Tank truck (0-8,000 gallons)

GROUP 5: Dumptor (over 6 yds.); Lowboy (50 tons & under); Self- loading Roll Off; Semi-Truck & Trailer; Tractor with Steer Trailer; Transit Mixers and Trucks Hauling Concrete (over 6 yds. to and including 10 yds.); Trucks, side, end, bottom and end dump (over 12 yds. to & including 20 yds.); Truck-Mounted Crane (with load bearing surface either mounted or pulled, up to 14 ton); Vacuum Truck (super sucker, guzzler, etc.)

GROUP 6: Flaherty Spreader Box Driver; Flowboys; Fork Lift (over 16,000 lbs.); Dumps (Semi-end); Mechanic (Field); Semi- end Dumps; Transfer Truck & Trailer; Transit Mixers & Trucks Hauling Concrete (over 10 yds. to & including 20 yds.); Trucks, side, end, bottom and articulated end dump (over 20 yds. to & including 40 yds.); Truck and Pup; Tournarocker, DWs & similar with 2 or more 4 wheel-power tractor with trailer, gallonage or yardage scale, whichever is greater Water Tank Truck (8,001- 14,000 gallons); Lowboy(over 50 tons)

GROUP 7: Oil Distributor Driver; Stringer Truck (cable oeprated trailer); Transit Mixers & Trucks Hauling Concrete (over 20 yds.); Truck, side, end, bottom end dump (over 40 yds. to & including 100 yds.); Truck Mounted Crane (with load bearing surface either mounted or pulled (16 through 25 tons);

GROUP 8: Prime Movers and Stinger Truck; Trucks, side, end, bottom and articulated end dump (over 100 yds.); Helicopter Pilot Hauling Employees or Materials

Footnote A - Anyone working on a HAZMAT job, where HAZMAT certification is required, shall be compensated as a premium, in additon to the classification working in as follows:

LEVEL C-D: - $.50 PER HOUR (This is the lowest level of protection. This level may use an air purifying respirator or additional protective clothing.

LEVEL A-B: - $1.00 PER HOUR (Uses supplied air is conjunction with a chemical spash suit or fully encapsulated suit with a self-contained breathing apparatus.

Employees shall be paid Hazmat pay in increments of four(4) and eight(8) hours.

NOTE:
Trucks Pulling Equipment Trailers: shall receive $.15/hour over applicable truck rate

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

State of Washington
Department of Labor & Industries

Prevailing Wage Section - Telephone 360-902-5335
PO Box 44540, Olympia, WA 98504-4540

Washington State Prevailing Wage

The PREVAILING WAGES listed here include both the hourly wage rate and the hourly rate of fringe benefits. On public works projects, worker's wage and benefit rates must add to not less than this total. A brief description of overtime calculation requirements are provided on the Benefit Code Key.

Journey Level Prevailing Wage Rates for the Effective Date: 04/05/2018

County	Trade	Job Classification	Wage	Holiday	Overtime	Note
Snohomish	Asbestos Abatement Workers	Journey Level	$46.57	5D	1H	
Snohomish	Boilermakers	Journey Level	$66.54	5N	1C	
Snohomish	Brick Mason	Journey Level	$55.82	5A	1M	
Snohomish	Brick Mason	Pointer-Caulker-Cleaner	$55.82	5A	1M	
Snohomish	Building Service Employees	Janitor	$11.50		1	
Snohomish	Building Service Employees	Shampooer	$11.50		1	
Snohomish	Building Service Employees	Waxer	$11.50		1	
Snohomish	Building Service Employees	Window Cleaner	$13.48		1	
Snohomish	Cabinet Makers (In Shop)	Journey Level	$15.08		1	
Snohomish	Carpenters	Acoustical Worker	$57.18	5D	4C	
Snohomish	Carpenters	Bridge, Dock And Wharf Carpenters	$57.18	5D	4C	
Snohomish	Carpenters	Carpenter	$57.18	5D	4C	
Snohomish	Carpenters	Carpenters on Stationary Tools	$57.31	5D	4C	
Snohomish	Carpenters	Creosoted Material	$57.28	5D	4C	
Snohomish	Carpenters	Floor Finisher	$57.18	5D	4C	
Snohomish	Carpenters	Floor Layer	$57.18	5D	4C	
Snohomish	Carpenters	Scaffold Erector	$57.18	5D	4C	
Snohomish	Cement Masons	Journey Level	$57.21	7A	1M	
Snohomish	Divers & Tenders	Bell/Vehicle or Submersible Operator (Not Under Pressure)	$110.54	5D	4C	
Snohomish	Divers & Tenders	Dive Supervisor/Master	$72.97	5D	4C	
Snohomish	Divers & Tenders	Diver	$110.54	5D	4C	8V
Snohomish	Divers & Tenders	Diver On Standby	$67.97	5D	4C	
Snohomish	Divers & Tenders	Diver Tender	$61.65	5D	4C	
Snohomish	Divers & Tenders	Manifold Operator	$61.65	5D	4C	
Snohomish	Divers & Tenders	Manifold Operator Mixed Gas	$66.65	5D	4C	
Snohomish	Divers & Tenders	Remote Operated Vehicle Operator/Technician	$61.65	5D	4C	

Snohomish	Divers & Tenders	Remote Operated Vehicle Tender	$57.43	5A	4C	
Snohomish	Dredge Workers	Assistant Engineer	$56.44	5D	3F	
Snohomish	Dredge Workers	Assistant Mate (Deckhand)	$56.00	5D	3F	
Snohomish	Dredge Workers	Boatmen	$56.44	5D	3F	
Snohomish	Dredge Workers	Engineer Welder	$57.51	5D	3F	
Snohomish	Dredge Workers	Leverman, Hydraulic	$58.67	5D	3F	
Snohomish	Dredge Workers	Mates	$56.44	5D	3F	
Snohomish	Dredge Workers	Oiler	$56.00	5D	3F	
Snohomish	Drywall Applicator	Journey Level	$56.78	5D	1H	
Snohomish	Drywall Tapers	Journey Level	$57.43	5P	1E	
Snohomish	Electrical Fixture Maintenance Workers	Journey Level	$13.76		1	
Snohomish	Electricians - Inside	Cable Splicer	$68.09	7H	1E	
Snohomish	Electricians - Inside	Construction Stock Person	$33.86	7H	1D	
Snohomish	Electricians - Inside	Journey Level	$63.51	7H	1E	
Snohomish	Electricians - Motor Shop	Craftsman	$15.37		1	
Snohomish	Electricians - Motor Shop	Journey Level	$14.69		1	
Snohomish	Electricians - Powerline Construction	Cable Splicer	$79.43	5A	4D	
Snohomish	Electricians - Powerline Construction	Certified Line Welder	$69.75	5A	4D	
Snohomish	Electricians - Powerline Construction	Groundperson	$46.28	5A	4D	
Snohomish	Electricians - Powerline Construction	Heavy Line Equipment Operator	$69.75	5A	4D	
Snohomish	Electricians - Powerline Construction	Journey Level Lineperson	$69.75	5A	4D	
Snohomish	Electricians - Powerline Construction	Line Equipment Operator	$59.01	5A	4D	
Snohomish	Electricians - Powerline Construction	Meter Installer	$46.28	5A	4D	8W
Snohomish	Electricians - Powerline Construction	Pole Sprayer	$69.75	5A	4D	
Snohomish	Electricians - Powerline Construction	Powderperson	$52.20	5A	4D	
Snohomish	Electronic Technicians	Journey Level	$30.10		1	
Snohomish	Elevator Constructors	Mechanic	$91.24	7D	4A	
Snohomish	Elevator Constructors	Mechanic In Charge	$98.51	7D	4A	
Snohomish	Fabricated Precast Concrete Products	Journey Level - In-Factory Work Only	$13.50		1	
Snohomish	Fence Erectors	Fence Erector	$14.00		1	
Snohomish	Flaggers	Journey Level	$39.48	7A	3I	
Snohomish	Glaziers	Journey Level	$61.81	7L	1Y	
Snohomish	Heat & Frost Insulators And Asbestos Workers	Journeyman	$67.93	5J	4H	
Snohomish	Heating Equipment Mechanics	Journey Level	$78.17	7F	1E	

Snohomish	Hod Carriers & Mason Tenders	Journey Level	$48.02	7A	3I	
Snohomish	Industrial Power Vacuum Cleaner	Journey Level	$11.50		1	
Snohomish	Inland Boatmen	Boat Operator	$61.41	5B	1K	
Snohomish	Inland Boatmen	Cook	$56.48	5B	1K	
Snohomish	Inland Boatmen	Deckhand	$57.48	5B	1K	
Snohomish	Inland Boatmen	Deckhand Engineer	$58.81	5B	1K	
Snohomish	Inland Boatmen	Launch Operator	$58.89	5B	1K	
Snohomish	Inland Boatmen	Mate	$57.31	5B	1K	
Snohomish	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Cleaner Operator, Foamer Operator	$11.50		1	
Snohomish	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Grout Truck Operator	$11.50		1	
Snohomish	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Head Operator	$12.78		1	
Snohomish	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Technician	$11.50		1	
Snohomish	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Tv Truck Operator	$11.50		1	
Snohomish	Insulation Applicators	Journey Level	$57.18	5D	4C	
Snohomish	Ironworkers	Journeyman	$67.88	7N	1O	
Snohomish	Laborers	Air, Gas Or Electric Vibrating Screed	$46.57	7A	3I	
Snohomish	Laborers	Airtrac Drill Operator	$48.02	7A	3I	
Snohomish	Laborers	Ballast Regular Machine	$46.57	7A	3I	
Snohomish	Laborers	Batch Weighman	$39.48	7A	3I	
Snohomish	Laborers	Brick Pavers	$46.57	7A	3I	
Snohomish	Laborers	Brush Cutter	$46.57	7A	3I	
Snohomish	Laborers	Brush Hog Feeder	$46.57	7A	3I	
Snohomish	Laborers	Burner	$46.57	7A	3I	
Snohomish	Laborers	Caisson Worker	$48.02	7A	3I	
Snohomish	Laborers	Carpenter Tender	$46.57	7A	3I	
Snohomish	Laborers	Caulker	$46.57	7A	3I	
Snohomish	Laborers	Cement Dumper-paving	$47.44	7A	3I	
Snohomish	Laborers	Cement Finisher Tender	$46.57	7A	3I	
Snohomish	Laborers	Change House Or Dry Shack	$46.57	7A	3I	
Snohomish	Laborers	Chipping Gun (under 30 Lbs.)	$46.57	7A	3I	
Snohomish	Laborers	Chipping Gun(30 Lbs. And Over)	$47.44	7A	3I	
Snohomish	Laborers	Choker Setter	$46.57	7A	3I	
Snohomish	Laborers	Chuck Tender	$46.57	7A	3I	
Snohomish	Laborers	Clary Power Spreader	$47.44	7A	3I	

Snohomish	Laborers	Clean-up Laborer	$46.57	7A	3I	
Snohomish	Laborers	Concrete Dumper/chute Operator	$47.44	7A	3I	
Snohomish	Laborers	Concrete Form Stripper	$46.57	7A	3I	
Snohomish	Laborers	Concrete Placement Crew	$47.44	7A	3I	
Snohomish	Laborers	Concrete Saw Operator/core Driller	$47.44	7A	3I	
Snohomish	Laborers	Crusher Feeder	$39.48	7A	3I	
Snohomish	Laborers	Curing Laborer	$46.57	7A	3I	
Snohomish	Laborers	Demolition: Wrecking & Moving (incl. Charred Material)	$46.57	7A	3I	
Snohomish	Laborers	Ditch Digger	$46.57	7A	3I	
Snohomish	Laborers	Diver	$48.02	7A	3I	
Snohomish	Laborers	Drill Operator (hydraulic,diamond)	$47.44	7A	3I	
Snohomish	Laborers	Dry Stack Walls	$46.57	7A	3I	
Snohomish	Laborers	Dump Person	$46.57	7A	3I	
Snohomish	Laborers	Epoxy Technician	$46.57	7A	3I	
Snohomish	Laborers	Erosion Control Worker	$46.57	7A	3I	
Snohomish	Laborers	Faller & Bucker Chain Saw	$47.44	7A	3I	
Snohomish	Laborers	Fine Graders	$46.57	7A	3I	
Snohomish	Laborers	Firewatch	$39.48	7A	3I	
Snohomish	Laborers	Form Setter	$46.57	7A	3I	
Snohomish	Laborers	Gabian Basket Builders	$46.57	7A	3I	
Snohomish	Laborers	General Laborer	$46.57	7A	3I	
Snohomish	Laborers	Grade Checker & Transit Person	$48.02	7A	3I	
Snohomish	Laborers	Grinders	$46.57	7A	3I	
Snohomish	Laborers	Grout Machine Tender	$46.57	7A	3I	
Snohomish	Laborers	Groutmen (pressure)including Post Tension Beams	$47.44	7A	3I	
Snohomish	Laborers	Guardrail Erector	$46.57	7A	3I	
Snohomish	Laborers	Hazardous Waste Worker (level A)	$48.02	7A	3I	
Snohomish	Laborers	Hazardous Waste Worker (level B)	$47.44	7A	3I	
Snohomish	Laborers	Hazardous Waste Worker (level C)	$46.57	7A	3I	
Snohomish	Laborers	High Scaler	$48.02	7A	3I	
Snohomish	Laborers	Jackhammer	$47.44	7A	3I	
Snohomish	Laborers	Laserbeam Operator	$47.44	7A	3I	
Snohomish	Laborers	Maintenance Person	$46.57	7A	3I	
Snohomish	Laborers	Manhole Builder-mudman	$47.44	7A	3I	
Snohomish	Laborers	Material Yard Person	$46.57	7A	3I	
Snohomish	Laborers	Motorman-dinky Locomotive	$47.44	7A	3I	
Snohomish	Laborers	Nozzleman (concrete Pump, Green Cutter When Using	$47.44	7A	3I	

		Combination Of High Pressure Air & Water On Concrete & Rock, Sandblast, Gunite, Shotcrete, Water Bla				
Snohomish	Laborers	Pavement Breaker	$47.44	7A	3I	
Snohomish	Laborers	Pilot Car	$39.48	7A	3I	
Snohomish	Laborers	Pipe Layer Lead	$48.02	7A	3I	
Snohomish	Laborers	Pipe Layer/tailor	$47.44	7A	3I	
Snohomish	Laborers	Pipe Pot Tender	$47.44	7A	3I	
Snohomish	Laborers	Pipe Reliner	$47.44	7A	3I	
Snohomish	Laborers	Pipe Wrapper	$47.44	7A	3I	
Snohomish	Laborers	Pot Tender	$46.57	7A	3I	
Snohomish	Laborers	Powderman	$48.02	7A	3I	
Snohomish	Laborers	Powderman's Helper	$46.57	7A	3I	
Snohomish	Laborers	Power Jacks	$47.44	7A	3I	
Snohomish	Laborers	Railroad Spike Puller - Power	$47.44	7A	3I	
Snohomish	Laborers	Raker - Asphalt	$48.02	7A	3I	
Snohomish	Laborers	Re-timberman	$48.02	7A	3I	
Snohomish	Laborers	Remote Equipment Operator	$47.44	7A	3I	
Snohomish	Laborers	Rigger/signal Person	$47.44	7A	3I	
Snohomish	Laborers	Rip Rap Person	$46.57	7A	3I	
Snohomish	Laborers	Rivet Buster	$47.44	7A	3I	
Snohomish	Laborers	Rodder	$47.44	7A	3I	
Snohomish	Laborers	Scaffold Erector	$46.57	7A	3I	
Snohomish	Laborers	Scale Person	$46.57	7A	3I	
Snohomish	Laborers	Sloper (over 20")	$47.44	7A	3I	
Snohomish	Laborers	Sloper Sprayer	$46.57	7A	3I	
Snohomish	Laborers	Spreader (concrete)	$47.44	7A	3I	
Snohomish	Laborers	Stake Hopper	$46.57	7A	3I	
Snohomish	Laborers	Stock Piler	$46.57	7A	3I	
Snohomish	Laborers	Tamper & Similar Electric, Air & Gas Operated Tools	$47.44	7A	3I	
Snohomish	Laborers	Tamper (multiple & Self-propelled)	$47.44	7A	3I	
Snohomish	Laborers	Timber Person - Sewer (lagger, Shorer & Cribber)	$47.44	7A	3I	
Snohomish	Laborers	Toolroom Person (at Jobsite)	$46.57	7A	3I	
Snohomish	Laborers	Topper	$46.57	7A	3I	
Snohomish	Laborers	Track Laborer	$46.57	7A	3I	
Snohomish	Laborers	Track Liner (power)	$47.44	7A	3I	
Snohomish	Laborers	Traffic Control Laborer	$42.22	7A	3I	8R
Snohomish	Laborers	Traffic Control Supervisor	$42.22	7A	3I	8R
Snohomish	Laborers	Truck Spotter	$46.57	7A	3I	
Snohomish	Laborers	Tugger Operator	$47.44	7A	3I	
Snohomish	Laborers	Tunnel Work-Compressed Air Worker 0-30 psi	$92.60	7A	3I	8Q
Snohomish	Laborers		$97.63	7A	3I	8Q

		Tunnel Work-Compressed Air Worker 30.01-44.00 psi				
Snohomish	Laborers	Tunnel Work-Compressed Air Worker 44.01-54.00 psi	$101.31	7A	3I	8Q
Snohomish	Laborers	Tunnel Work-Compressed Air Worker 54.01-60.00 psi	$107.01	7A	3I	8Q
Snohomish	Laborers	Tunnel Work-Compressed Air Worker 60.01-64.00 psi	$109.13	7A	3I	8Q
Snohomish	Laborers	Tunnel Work-Compressed Air Worker 64.01-68.00 psi	$114.23	7A	3I	8Q
Snohomish	Laborers	Tunnel Work-Compressed Air Worker 68.01-70.00 psi	$116.13	7A	3I	8Q
Snohomish	Laborers	Tunnel Work-Compressed Air Worker 70.01-72.00 psi	$118.13	7A	3I	8Q
Snohomish	Laborers	Tunnel Work-Compressed Air Worker 72.01-74.00 psi	$120.13	7A	3I	8Q
Snohomish	Laborers	Tunnel Work-Guage and Lock Tender	$48.12	7A	3I	8Q
Snohomish	Laborers	Tunnel Work-Miner	$48.12	7A	3I	8Q
Snohomish	Laborers	Vibrator	$47.44	7A	3I	
Snohomish	Laborers	Vinyl Seamer	$46.57	7A	3I	
Snohomish	Laborers	Watchman	$35.88	7A	3I	
Snohomish	Laborers	Welder	$47.44	7A	3I	
Snohomish	Laborers	Well Point Laborer	$47.44	7A	3I	
Snohomish	Laborers	Window Washer/cleaner	$35.88	7A	3I	
Snohomish	Laborers - Underground Sewer & Water	General Laborer & Topman	$46.57	7A	3I	
Snohomish	Laborers - Underground Sewer & Water	Pipe Layer	$47.44	7A	3I	
Snohomish	Landscape Construction	Irrigation Or Lawn Sprinkler Installers	$17.31		1	
Snohomish	Landscape Construction	Landscape Equipment Operators Or Truck Drivers	$20.06		1	
Snohomish	Landscape Construction	Landscaping Or Planting Laborers	$14.13		1	
Snohomish	Lathers	Journey Level	$56.78	5D	1H	
Snohomish	Marble Setters	Journey Level	$55.82	5A	1M	
Snohomish	Metal Fabrication (In Shop)	Fitter	$15.38		1	
Snohomish	Metal Fabrication (In Shop)	Laborer	$11.50		1	
Snohomish	Metal Fabrication (In Shop)	Machine Operator	$11.50		1	
Snohomish	Metal Fabrication (In Shop)	Painter	$11.50		1	
Snohomish	Metal Fabrication (In Shop)	Welder	$15.38		1	
Snohomish	Millwright	Journey Level	$58.68	5D	4C	
Snohomish	Modular Buildings	Journey Level	$11.50		1	
Snohomish	Painters	Journey Level	$41.60	6Z	2B	
Snohomish	Pile Driver	Crew Tender	$52.37	5D	4C	
Snohomish	Pile Driver	Hyperbaric Worker - Compressed Air Worker 0-30.00 PSI	$71.35	5D	4C	

Snohomish	Pile Driver	Hyperbaric Worker - Compressed Air Worker 30.01 - 44.00 PSI	$76.35	5D	4C	
Snohomish	Pile Driver	Hyperbaric Worker - Compressed Air Worker 44.01 - 54.00 PSI	$80.35	5D	4C	
Snohomish	Pile Driver	Hyperbaric Worker - Compressed Air Worker 54.01 - 60.00 PSI	$85.35	5D	4C	
Snohomish	Pile Driver	Hyperbaric Worker - Compressed Air Worker 60.01 - 64.00 PSI	$87.85	5D	4C	
Snohomish	Pile Driver	Hyperbaric Worker - Compressed Air Worker 64.01 - 68.00 PSI	$92.85	5D	4C	
Snohomish	Pile Driver	Hyperbaric Worker - Compressed Air Worker 68.01 - 70.00 PSI	$94.85	5D	4C	
Snohomish	Pile Driver	Hyperbaric Worker - Compressed Air Worker 70.01 - 72.00 PSI	$96.85	5D	4C	
Snohomish	Pile Driver	Hyperbaric Worker - Compressed Air Worker 72.01 - 74.00 PSI	$98.85	5D	4C	
Snohomish	Pile Driver	Journey Level	$57.43	5D	4C	
Snohomish	Plasterers	Journey Level	$54.89	7Q	1R	
Snohomish	Playground & Park Equipment Installers	Journey Level	$11.94		1	
Snohomish	Plumbers & Pipefitters	Journey Level	$67.47	5A	1G	
Snohomish	Power Equipment Operators	Asphalt Plant Operators	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Assistant Engineer	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Barrier Machine (zipper)	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Batch Plant Operator, Concrete	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Bobcat	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Brokk - Remote Demolition Equipment	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Brooms	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Bump Cutter	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Cableways	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Chipper	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Compressor	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Concrete Pump: Truck Mount With Boom Attachment Over 42 M	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Concrete Finish Machine -laser Screed	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Concrete Pump - Mounted Or Trailer High Pressure Line Pump, Pump High Pressure.	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators		$59.96	7A	3C	8P

		Concrete Pump: Truck Mount With Boom Attachment Up To 42m				
Snohomish	Power Equipment Operators	Conveyors	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Cranes Friction: 200 tons and over	$62.33	7A	3C	8P
Snohomish	Power Equipment Operators	Cranes: 20 Tons Through 44 Tons With Attachments	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Cranes: 100 Tons Through 199 Tons, Or 150' Of Boom (Including Jib With Attachments)	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators	Cranes: 200 tons- 299 tons, or 250’ of boom including jib with attachments	$61.72	7A	3C	8P
Snohomish	Power Equipment Operators	Cranes: 300 tons and over or 300’ of boom including jib with attachments	$62.33	7A	3C	8P
Snohomish	Power Equipment Operators	Cranes: 45 Tons Through 99 Tons, Under 150' Of Boom (including Jib With Attachments)	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Cranes: A-frame - 10 Tons And Under	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Cranes: Friction cranes through 199 tons	$61.72	7A	3C	8P
Snohomish	Power Equipment Operators	Cranes: Through 19 Tons With Attachments A-frame Over 10 Tons	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Crusher	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Deck Engineer/deck Winches (power)	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Derricks, On Building Work	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Dozers D-9 & Under	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Drill Oilers: Auger Type, Truck Or Crane Mount	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Drilling Machine	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators	Elevator And Man-lift: Permanent And Shaft Type	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Finishing Machine, Bidwell And Gamaco & Similar Equipment	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Forklift: 3000 Lbs And Over With Attachments	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Forklifts: Under 3000 Lbs. With Attachments	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Grade Engineer: Using Blue Prints, Cut Sheets, Etc	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Gradechecker/stakeman	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Guardrail Punch	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators		$60.49	7A	3C	8P

		Hard Tail End Dump Articulating Off- Road Equipment 45 Yards. & Over				
Snohomish	Power Equipment Operators	Hard Tail End Dump Articulating Off-road Equipment Under 45 Yards	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Horizontal/directional Drill Locator	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Horizontal/directional Drill Operator	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Hydralifts/boom Trucks Over 10 Tons	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Hydralifts/boom Trucks, 10 Tons And Under	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Loader, Overhead 8 Yards. & Over	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators	Loader, Overhead, 6 Yards. But Not Including 8 Yards	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Loaders, Overhead Under 6 Yards	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Loaders, Plant Feed	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Loaders: Elevating Type Belt	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Locomotives, All	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Material Transfer Device	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Mechanics, All (leadmen - $0.50 Per Hour Over Mechanic)	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators	Motor Patrol Graders	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Mucking Machine, Mole, Tunnel Drill, Boring, Road Header And/or Shield	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Oil Distributors, Blower Distribution & Mulch Seeding Operator	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Outside Hoists (elevators And Manlifts), Air Tuggers,strato	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Overhead, Bridge Type Crane: 20 Tons Through 44 Tons	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Overhead, Bridge Type: 100 Tons And Over	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators	Overhead, Bridge Type: 45 Tons Through 99 Tons	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Pavement Breaker	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Pile Driver (other Than Crane Mount)	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Plant Oiler - Asphalt, Crusher	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Posthole Digger, Mechanical	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Power Plant	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Pumps - Water	$56.90	7A	3C	8P

Snohomish	Power Equipment Operators	Quad 9, Hd 41, D10 And Over	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Quick Tower - No Cab, Under 100 Feet In Height Based To Boom	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Remote Control Operator On Rubber Tired Earth Moving Equipment	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Rigger And Bellman	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Rigger/Signal Person, Bellman (Certified)	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Rollagon	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Roller, Other Than Plant Mix	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Roller, Plant Mix Or Multi-lift Materials	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Roto-mill, Roto-grinder	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Saws - Concrete	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Scraper, Self Propelled Under 45 Yards	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Scrapers - Concrete & Carry All	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Scrapers, Self-propelled: 45 Yards And Over	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Service Engineers - Equipment	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Shotcrete/gunite Equipment	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Shovel , Excavator, Backhoe, Tractors Under 15 Metric Tons.	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Shovel, Excavator, Backhoe: Over 30 Metric Tons To 50 Metric Tons	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Shovel, Excavator, Backhoes, Tractors: 15 To 30 Metric Tons	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Shovel, Excavator, Backhoes: Over 50 Metric Tons To 90 Metric Tons	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators	Shovel, Excavator, Backhoes: Over 90 Metric Tons	$61.72	7A	3C	8P
Snohomish	Power Equipment Operators	Slipform Pavers	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Spreader, Topsider & Screedman	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Subgrader Trimmer	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Tower Bucket Elevators	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Tower Crane Up To 175' In Height Base To Boom	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators	Tower Crane: over 175’ through 250’ in height, base to boom	$61.72	7A	3C	8P
Snohomish	Power Equipment Operators	Tower Cranes: over 250’ in height from base to boom	$62.33	7A	3C	8P

Snohomish	Power Equipment Operators	Transporters, All Track Or Truck Type	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Trenching Machines	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Truck Crane Oiler/driver - 100 Tons And Over	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Truck Crane Oiler/driver Under 100 Tons	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators	Truck Mount Portable Conveyor	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators	Welder	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators	Wheel Tractors, Farmall Type	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators	Yo Yo Pay Dozer	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Asphalt Plant Operators	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Assistant Engineer	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Barrier Machine (zipper)	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Batch Plant Operator, Concrete	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Bobcat	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Brokk - Remote Demolition Equipment	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Brooms	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Bump Cutter	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Cableways	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Chipper	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Compressor	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Concrete Pump: Truck Mount With Boom Attachment Over 42 M	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Concrete Finish Machine -laser Screed	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Concrete Pump - Mounted Or Trailer High Pressure Line Pump, Pump High Pressure.	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Concrete Pump: Truck Mount With Boom Attachment Up To 42m	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Conveyors	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Cranes Friction: 200 tons and over	$62.33	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Cranes: 20 Tons Through 44 Tons With Attachments	$59.96	7A	3C	8P

Snohomish	Power Equipment Operators-Underground Sewer & Water	Cranes: 100 Tons Through 199 Tons, Or 150' Of Boom (Including Jib With Attachments)	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Cranes: 200 tons- 299 tons, or 250’ of boom including jib with attachments	$61.72	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Cranes: 300 tons and over or 300’ of boom including jib with attachments	$62.33	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Cranes: 45 Tons Through 99 Tons, Under 150' Of Boom (including Jib With Attachments)	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Cranes: A-frame - 10 Tons And Under	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Cranes: Friction cranes through 199 tons	$61.72	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Cranes: Through 19 Tons With Attachments A-frame Over 10 Tons	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Crusher	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Deck Engineer/deck Winches (power)	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Derricks, On Building Work	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Dozers D-9 & Under	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Drill Oilers: Auger Type, Truck Or Crane Mount	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Drilling Machine	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Elevator And Man-lift: Permanent And Shaft Type	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Finishing Machine, Bidwell And Gamaco & Similar Equipment	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Forklift: 3000 Lbs And Over With Attachments	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Forklifts: Under 3000 Lbs. With Attachments	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Grade Engineer: Using Blue Prints, Cut Sheets, Etc	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Gradechecker/stakeman	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Guardrail Punch	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Hard Tail End Dump Articulating Off- Road Equipment 45 Yards. & Over	$60.49	7A	3C	8P
Snohomish			$59.96	7A	3C	8P

	Power Equipment Operators-Underground Sewer & Water	Hard Tail End Dump Articulating Off-road Equipment Under 45 Yards				
Snohomish	Power Equipment Operators-Underground Sewer & Water	Horizontal/directional Drill Locator	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Horizontal/directional Drill Operator	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Hydralifts/boom Trucks Over 10 Tons	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Hydralifts/boom Trucks, 10 Tons And Under	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Loader, Overhead 8 Yards. & Over	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Loader, Overhead, 6 Yards. But Not Including 8 Yards	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Loaders, Overhead Under 6 Yards	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Loaders, Plant Feed	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Loaders: Elevating Type Belt	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Locomotives, All	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Material Transfer Device	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Mechanics, All (leadmen - $0.50 Per Hour Over Mechanic)	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Motor Patrol Graders	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Mucking Machine, Mole, Tunnel Drill, Boring, Road Header And/or Shield	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Oil Distributors, Blower Distribution & Mulch Seeding Operator	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Outside Hoists (elevators And Manlifts), Air Tuggers,strato	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Overhead, Bridge Type Crane: 20 Tons Through 44 Tons	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Overhead, Bridge Type: 100 Tons And Over	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Overhead, Bridge Type: 45 Tons Through 99 Tons	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Pavement Breaker	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Pile Driver (other Than Crane Mount)	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Plant Oiler - Asphalt, Crusher	$59.49	7A	3C	8P
Snohomish		Posthole Digger, Mechanical	$56.90	7A	3C	8P

	Power Equipment Operators-Underground Sewer & Water					
Snohomish	Power Equipment Operators-Underground Sewer & Water	Power Plant	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Pumps - Water	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Quad 9, Hd 41, D10 And Over	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Quick Tower - No Cab, Under 100 Feet In Height Based To Boom	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Remote Control Operator On Rubber Tired Earth Moving Equipment	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Rigger And Bellman	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Rigger/Signal Person, Bellman (Certified)	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Rollagon	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Roller, Other Than Plant Mix	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Roller, Plant Mix Or Multi-lift Materials	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Roto-mill, Roto-grinder	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Saws - Concrete	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Scraper, Self Propelled Under 45 Yards	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Scrapers - Concrete & Carry All	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Scrapers, Self-propelled: 45 Yards And Over	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Service Engineers - Equipment	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Shotcrete/gunite Equipment	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Shovel , Excavator, Backhoe, Tractors Under 15 Metric Tons.	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoe: Over 30 Metric Tons To 50 Metric Tons	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes, Tractors: 15 To 30 Metric Tons	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes: Over 50 Metric Tons To 90 Metric Tons	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Shovel, Excavator, Backhoes: Over 90 Metric Tons	$61.72	7A	3C	8P

Snohomish	Power Equipment Operators-Underground Sewer & Water	Slipform Pavers	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Spreader, Topsider & Screedman	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Subgrader Trimmer	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Tower Bucket Elevators	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Tower Crane Up To 175' In Height Base To Boom	$61.10	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Tower Crane: over 175' through 250' in height, base to boom	$61.72	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Tower Cranes: over 250' in height from base to boom	$62.33	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Transporters, All Track Or Truck Type	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Trenching Machines	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Truck Crane Oiler/driver - 100 Tons And Over	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Truck Crane Oiler/driver Under 100 Tons	$59.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Truck Mount Portable Conveyor	$59.96	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Welder	$60.49	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Wheel Tractors, Farmall Type	$56.90	7A	3C	8P
Snohomish	Power Equipment Operators-Underground Sewer & Water	Yo Yo Pay Dozer	$59.96	7A	3C	8P
Snohomish	Power Line Clearance Tree Trimmers	Journey Level In Charge	$50.02	5A	4A	
Snohomish	Power Line Clearance Tree Trimmers	Spray Person	$47.43	5A	4A	
Snohomish	Power Line Clearance Tree Trimmers	Tree Equipment Operator	$50.02	5A	4A	
Snohomish	Power Line Clearance Tree Trimmers	Tree Trimmer	$44.64	5A	4A	
Snohomish	Power Line Clearance Tree Trimmers	Tree Trimmer Groundperson	$33.67	5A	4A	
Snohomish	Refrigeration & Air Conditioning Mechanics	Mechanic	$67.47	5A	1G	
Snohomish	Residential Brick Mason	Journey Level	$20.00		1	
Snohomish	Residential Carpenters	Journey Level	$42.86	5D	4C	
Snohomish	Residential Cement Masons	Journey Level	$14.00		1	
Snohomish	Residential Drywall Applicators	Journey Level	$42.86	5D	4C	
Snohomish	Residential Drywall Tapers	Journey Level	$57.43	5P	1E	
Snohomish	Residential Electricians	Journey Level	$32.24	7F	1D	

Snohomish	Residential Glaziers	Journey Level	$41.05	7L	1H	
Snohomish	Residential Insulation Applicators	Journey Level	$25.68		1	
Snohomish	Residential Laborers	Journey Level	$20.73		1	
Snohomish	Residential Marble Setters	Journey Level	$30.74		1	
Snohomish	Residential Painters	Journey Level	$17.46		1	
Snohomish	Residential Plumbers & Pipefitters	Journey Level	$28.99		1	
Snohomish	Residential Refrigeration & Air Conditioning Mechanics	Journey Level	$39.88	5A	1G	
Snohomish	Residential Sheet Metal Workers	Journey Level (Field or Shop)	$44.56	7F	1R	
Snohomish	Residential Soft Floor Layers	Journey Level	$47.61	5A	3J	
Snohomish	Residential Sprinkler Fitters (Fire Protection)	Journey Level	$46.58	5C	2R	
Snohomish	Residential Stone Masons	Journey Level	$30.74		1	
Snohomish	Residential Terrazzo Workers	Journey Level	$11.50		1	
Snohomish	Residential Terrazzo/Tile Finishers	Journey Level	$21.60		1	
Snohomish	Residential Tile Setters	Journey Level	$20.32		1	
Snohomish	Roofers	Journey Level	$51.02	5A	3H	
Snohomish	Roofers	Using Irritable Bituminous Materials	$54.02	5A	3H	
Snohomish	Sheet Metal Workers	Journey Level (Field or Shop)	$78.17	7F	1E	
Snohomish	Shipbuilding & Ship Repair	Boilermaker	$43.31	7M	1H	
Snohomish	Shipbuilding & Ship Repair	Carpenter	$41.56	7R	2B	
Snohomish	Shipbuilding & Ship Repair	Electrician	$42.34	5T	3E	
Snohomish	Shipbuilding & Ship Repair	Heat & Frost Insulator	$67.93	5J	4H	
Snohomish	Shipbuilding & Ship Repair	Laborer	$42.34	5T	3E	
Snohomish	Shipbuilding & Ship Repair	Machinist	$42.34	5T	3E	
Snohomish	Shipbuilding & Ship Repair	Painter	$41.60	6Z	2B	
Snohomish	Shipbuilding & Ship Repair	Shipfitter	$42.34	5T	3E	
Snohomish	Shipbuilding & Ship Repair	Welder/Burner	$42.34	5T	3E	
Snohomish	Sign Makers & Installers (Electrical)	Sign Installer	$26.56		1	
Snohomish	Sign Makers & Installers (Electrical)	Sign Maker	$20.50		1	
Snohomish	Sign Makers & Installers (Non-Electrical)	Sign Installer	$22.56		1	
Snohomish	Sign Makers & Installers (Non-Electrical)	Sign Maker	$20.50		1	
Snohomish	Soft Floor Layers	Journey Level	$47.61	5A	3J	
Snohomish	Solar Controls For Windows	Journey Level	$11.50		1	
Snohomish	Sprinkler Fitters (Fire Protection)	Journey Level	$75.64	5C	1X	
Snohomish	Stage Rigging Mechanics (Non Structural)	Journey Level	$13.23		1	
Snohomish	Stone Masons	Journey Level	$55.82	5A	1M	

Snohomish	Street And Parking Lot Sweeper Workers	Journey Level	$15.00		1	
Snohomish	Surveyors	Assistant Construction Site Surveyor	$59.49	7A	3C	8P
Snohomish	Surveyors	Chainman	$58.93	7A	3C	8P
Snohomish	Surveyors	Construction Site Surveyor	$60.49	7A	3C	8P
Snohomish	Telecommunication Technicians	Journey Level	$22.38		1	
Snohomish	Telephone Line Construction - Outside	Cable Splicer	$40.52	5A	2B	
Snohomish	Telephone Line Construction - Outside	Hole Digger/Ground Person	$22.78	5A	2B	
Snohomish	Telephone Line Construction - Outside	Installer (Repairer)	$38.87	5A	2B	
Snohomish	Telephone Line Construction - Outside	Special Aparatus Installer I	$40.52	5A	2B	
Snohomish	Telephone Line Construction - Outside	Special Apparatus Installer II	$39.73	5A	2B	
Snohomish	Telephone Line Construction - Outside	Telephone Equipment Operator (Heavy)	$40.52	5A	2B	
Snohomish	Telephone Line Construction - Outside	Telephone Equipment Operator (Light)	$37.74	5A	2B	
Snohomish	Telephone Line Construction - Outside	Telephone Lineperson	$37.74	5A	2B	
Snohomish	Telephone Line Construction - Outside	Television Groundperson	$21.60	5A	2B	
Snohomish	Telephone Line Construction - Outside	Television Lineperson/Installer	$28.68	5A	2B	
Snohomish	Telephone Line Construction - Outside	Television System Technician	$34.10	5A	2B	
Snohomish	Telephone Line Construction - Outside	Television Technician	$30.69	5A	2B	
Snohomish	Telephone Line Construction - Outside	Tree Trimmer	$37.74	5A	2B	
Snohomish	Terrazzo Workers	Journey Level	$51.36	5A	1M	
Snohomish	Tile Setters	Journey Level	$51.36	5A	1M	
Snohomish	Tile, Marble & Terrazzo Finishers	Finisher	$42.19	5A	1B	
Snohomish	Traffic Control Stripers	Journey Level	$45.43	7A	1K	
Snohomish	Truck Drivers	Asphalt Mix Over 16 Yards (W. WA-Joint Council 28)	$52.70	5D	3A	8L
Snohomish	Truck Drivers	Asphalt Mix To 16 Yards (W. WA-Joint Council 28)	$51.86	5D	3A	8L
Snohomish	Truck Drivers	Dump Truck	$37.94		1	
Snohomish	Truck Drivers	Dump Truck And Trailer	$38.52		1	
Snohomish	Truck Drivers	Other Trucks	$38.52		1	
Snohomish	Truck Drivers	Transit Mixer	$34.63		1	
Snohomish	Well Drillers & Irrigation Pump Installers	Irrigation Pump Installer	$17.05		1	
Snohomish		Oiler	$13.93		1	

	Well Drillers & Irrigation Pump Installers					
Snohomish	Well Drillers & Irrigation Pump Installers	Well Driller	$19.01		1	

Washington State Department of Labor and Industries
Policy Statement
(Regarding the Production of "Standard" or "Non-standard" Items)

Below is the department's (State L&I's) list of criteria to be used in determining whether a prefabricated item is "standard" or "non-standard". For items not appearing on WSDOT's predetermined list, these criteria shall be used by the Contractor (and the Contractor's subcontractors, agents to subcontractors, suppliers, manufacturers, and fabricators) to determine coverage under RCW 39.12. The production, in the State of Washington, of non-standard items is covered by RCW 39.12, and the production of standard items is not. The production of any item outside the State of Washington is not covered by RCW 39.12.

1. Is the item fabricated for a public works project? If not, it is not subject to RCW 39.12. If it is, go to question 2.

2. Is the item fabricated on the public works jobsite? If it is, the work is covered under RCW 39.12. If not, go to question 3.

3. Is the item fabricated in an assembly/fabrication plant set up for, and dedicated primarily to, the public works project? If it is, the work is covered by RCW 39.12. If not, go to question 4.

4. Does the item require any assembly, cutting, modification or other fabrication by the supplier? If not, the work is not covered by RCW 39.12. If yes, go to question 5.

5. Is the prefabricated item intended for the public works project typically an inventory item which could reasonably be sold on the general market? If not, the work is covered by RCW 39.12. If yes, go to question 6.

6. Does the specific prefabricated item, generally defined as standard, have any unusual characteristics such as shape, type of material, strength requirements, finish, etc? If yes, the work is covered under RCW 39.12.

Any firm with questions regarding the policy, WSDOT's Predetermined List, or for determinations of covered and non-covered workers shall be directed to State L&I at (360) 902-5330.

WSDOT's
Predetermined List for
Suppliers - Manufactures - Fabricator

Below is a list of potentially prefabricated items, originally furnished by WSDOT to Washington State Department of Labor and Industries, that may be considered non-standard and therefore covered by the prevailing wage law, RCW 39.12. Items marked with an X in the "YES" column should be considered to be non-standard and therefore covered by RCW 39.12. Items marked with an X in the "NO" column should be considered to be standard and therefore not covered. Of course, exceptions to this general list may occur, and in that case shall be evaluated according to the criteria described in State and L&I's policy statement.

	ITEM DESCRIPTION	YES	NO
1.	Metal rectangular frames, solid metal covers, herringbone grates, and bi-directional vaned grates for Catch Basin Types 1, 1L, 1P, and 2 and Concrete Inlets. See Std. Plans		X
2.	Metal circular frames (rings) and covers, circular grates, and prefabricated ladders for Manhole Types 1, 2, and 3, Drywell Types 1, 2, and 3 and Catch Basin Type 2. See Std. Plans		X
3.	Prefabricated steel grate supports and welded grates, metal frames and dual vaned grates, and Type 1, 2, and 3 structural tubing grates for Drop Inlets. See Std. Plans.		X
4.	Concrete Pipe - Plain Concrete pipe and reinforced concrete pipe Class 2 to 5 sizes smaller than 60 inch diameter.		X
5.	Concrete Pipe - Plain Concrete pipe and reinforced concrete pipe Class 2 to 5 sizes larger than 60 inch diameter.		X
6.	Corrugated Steel Pipe - Steel lock seam corrugated pipe for culverts and storm sewers, sizes 30 inch to 120 inches in diameter. May also be treated, 1 thru 5.		X
7.	Corrugated Aluminum Pipe - Aluminum lock seam corrugated pipe for culverts and storm sewers, sizes 30 inch to 120 inches in diameter. May also be treated, #5.		X

	ITEM DESCRIPTION	YES	NO
8.	Anchor Bolts & Nuts - Anchor Bolts and Nuts, for mounting sign structures, luminaries and other items, shall be made from commercial bolt stock. See Contract Plans and Std. Plans for size and material type.		X
9.	Aluminum Pedestrian Handrail - Pedestrian handrail conforming to the type and material specifications set forth in the contract plans. Welding of aluminum shall be in accordance with Section 9-28.14(3).	X	
10.	Major Structural Steel Fabrication - Fabrication of major steel items such as trusses, beams, girders, etc., for bridges.	X	
11.	Minor Structural Steel Fabrication - Fabrication of minor steel Items such as special hangers, brackets, access doors for structures, access ladders for irrigation boxes, bridge expansion joint systems, etc., involving welding, cutting, punching and/or boring of holes. See Contact Plans for item description and shop drawings.	X	
12.	Aluminum Bridge Railing Type BP - Metal bridge railing conforming to the type and material specifications set forth in the Contract Plans. Welding of aluminum shall be in accordance with Section 9-28.14(3).		X
13.	Concrete Piling--Precast-Prestressed concrete piling for use as 55 and 70 ton concrete piling. Concrete to conform to Section 9-19.1 of Std. Spec..	X	
14.	Precast Manhole Types 1, 2, and 3 with cones, adjustment sections and flat top slabs. See Std. Plans.		X
15.	Precast Drywell Types 1, 2, and with cones and adjustment Sections. See Std. Plans.		X
16.	Precast Catch Basin - Catch Basin type 1, 1L, 1P, and 2 With adjustment sections. See Std. Plans.		X

	ITEM DESCRIPTION	YES	NO
17.	Precast Concrete Inlet - with adjustment sections, See Std. Plans		X
18.	Precast Drop Inlet Type 1 and 2 with metal grate supports. See Std. Plans.		X
19.	Precast Grate Inlet Type 2 with extension and top units. See Std. Plans		X
20.	Metal frames, vaned grates, and hoods for Combination Inlets. See Std. Plans		X
21.	Precast Concrete Utility Vaults - Precast Concrete utility vaults of various sizes. Used for in ground storage of utility facilities and controls. See Contract Plans for size and construction requirements. Shop drawings are to be provided for approval prior to casting		X
22.	Vault Risers - For use with Valve Vaults and Utilities X Vaults.		X
23.	Valve Vault - For use with underground utilities. See Contract Plans for details.		X
24.	Precast Concrete Barrier - Precast Concrete Barrier for use as new barrier or may also be used as Temporary Concrete Barrier. Only new state approved barrier may be used as permanent barrier.		X
25.	Reinforced Earth Wall Panels – Reinforced Earth Wall Panels in size and shape as shown in the Plans. Fabrication plant has annual approval for methods and materials to be used. See Shop Drawing. Fabrication at other locations may be approved, after facilities inspection, contact HQ. Lab.	X	
26.	Precast Concrete Walls - Precast Concrete Walls - tilt-up wall panel in size and shape as shown in Plans. Fabrication plant has annual approval for methods and materials to be used	X	

	ITEM DESCRIPTION	YES	NO
27.	Precast Railroad Crossings - Concrete Crossing Structure Slabs.	X	
28.	12, 18 and 26 inch Standard Precast Prestressed Girder – Standard Precast Prestressed Girder for use in structures. Fabricator plant has annual approval of methods and materials to be used. Shop Drawing to be provided for approval prior to casting girders. See Std. Spec. Section 6-02.3(25)A	X	
29.	Prestressed Concrete Girder Series 4-14 - Prestressed Concrete Girders for use in structures. Fabricator plant has annual approval of methods and materials to be used. Shop Drawing to be provided for approval prior to casting girders. See Std. Spec. Section 6-02.3(25)A .	X	
30.	Prestressed Tri-Beam Girder - Prestressed Tri-Beam Girders for use in structures. Fabricator plant has annual approval of methods and materials to be used. Shop Drawing to be provided for approval prior to casting girders. See Std. Spec. Section 6-02.3(25)A	X	
31.	Prestressed Precast Hollow-Core Slab – Precast Prestressed Hollow-core slab for use in structures. Fabricator plant has annual approval of methods and materials to be used. Shop Drawing to be provided for approval prior to casting girders. See Std. Spec. Section 6-02.3(25)A.	X	
32.	Prestressed-Bulb Tee Girder - Bulb Tee Prestressed Girder for use in structures. Fabricator plant has annual approval of methods and materials to be used. Shop Drawing to be provided for approval prior to casting girders. See Std. Spec. Section 6-02.3(25)A	X	
33.	Monument Case and Cover See Std. Plan.		X

	ITEM DESCRIPTION	YES	NO
34.	Cantilever Sign Structure - Cantilever Sign Structure fabricated from steel tubing meeting AASHTO-M-183. See Std. Plans, and Contract Plans for details. The steel structure shall be galvanized after fabrication in accordance with AASHTO-M-111.	X	
35.	Mono-tube Sign Structures - Mono-tube Sign Bridge fabricated to details shown in the Plans. Shop drawings for approval are required prior to fabrication.	X	
36.	Steel Sign Bridges - Steel Sign Bridges fabricated from steel tubing meeting AASHTO-M-138 for Aluminum Alloys. See Std. Plans, and Contract Plans for details. The steel structure shall be galvanized after fabrication in accordance with AASHTO-M-111.	X	
37.	Steel Sign Post - Fabricated Steel Sign Posts as detailed in Std Plans. Shop drawings for approval are to be provided prior to fabrication		X
38.	Light Standard-Prestressed - Spun, prestressed, hollow concrete poles.	X	
39.	Light Standards - Lighting Standards for use on highway illumination systems, poles to be fabricated to conform with methods and materials as specified on Std. Plans. See Specia Provisions for pre-approved drawings.	X	
40.	Traffic Signal Standards - Traffic Signal Standards for use on highway and/or street signal systems. Standards to be fabricated to conform with methods and material as specified on Std. Plans. See Special Provisions for pre-approved drawings	X	
41.	Precast Concrete Sloped Mountable Curb (Single and DualFaced) See Std. Plans.		X

	ITEM DESCRIPTION	YES	NO
42.	Traffic Signs - Prior to approval of a Fabricator of Traffic Signs, the sources of the following materials must be submitted and approved for reflective sheeting, legend material, and aluminum sheeting. **NOTE:** *** Fabrication inspection required. Only signs tagged "Fabrication Approved" by WSDOT Sign Fabrication Inspector to be installed	**X**	**X**
		Custom Message	Std Signing Message
43.	Cutting & bending reinforcing steel		**X**
44.	Guardrail components	**X**	**X**
		Custom End Sec	Standard Sec
45.	Aggregates/Concrete mixes	Covered by WAC 296-127-018	
46.	Asphalt	Covered by WAC 296-127-018	
47.	Fiber fabrics		**X**
48.	Electrical wiring/components		**X**
49.	treated or untreated timber pile		**X**
50.	Girder pads (elastomeric bearing)	**X**	
51.	Standard Dimension lumber		**X**
52.	Irrigation components		**X**

ITEM DESCRIPTION	YES	NO
53. Fencing materials		X
54. Guide Posts		X
55. Traffic Buttons		X
56. Epoxy		X
57. Cribbing		X
58. Water distribution materials		X
59. Steel "H" piles		X
60. Steel pipe for concrete pile casings		X
61. Steel pile tips, standard		X
62. Steel pile tips, custom	X	

Prefabricated items specifically produced for public works projects that are prefabricated in a county other than the county wherein the public works project is to be completed, the wage for the offsite prefabrication shall be the applicable prevailing wage for the county in which the actual prefabrication takes place.

It is the manufacturer of the prefabricated product to verify that the correct county wage rates are applied to work they perform.

See RCW 39.12.010
(The definition of "locality" in RCW 39.12.010(2) contains the phrase "wherein the physical work is being performed." The department interprets this phrase to mean the actual work site.

WSDOT's List of State Occupations not applicable to Heavy and Highway Construction Projects

This project is subject to the state hourly minimum rates for wages and fringe benefits in the contract provisions, as provided by the state Department of Labor and Industries.
The following list of occupations, is comprised of those occupations that are not normally used in the construction of heavy and highway projects.
When considering job classifications for use and / or payment when bidding on, or building heavy and highway construction projects for, or administered by WSDOT, these Occupations will be excepted from the included "Washington State Prevailing Wage Rates For Public Work Contracts" documents.

- Building Service Employees
- Electrical Fixture Maintenance Workers
- Electricians - Motor Shop
- Heating Equipment Mechanics
- Industrial Engine and Machine Mechanics
- Industrial Power Vacuum Cleaners
- Inspection, Cleaning, Sealing of Water Systems by Remote Control
- Laborers - Underground Sewer & Water
- Machinists (Hydroelectric Site Work)
- Modular Buildings
- Playground & Park Equipment Installers
- Power Equipment Operators - Underground Sewer & Water
- Residential *** ALL ASSOCIATED RATES ***
- Sign Makers and Installers (Non-Electrical)
- Sign Makers and Installers (Electrical)
- Stage Rigging Mechanics (Non Structural)

The following occupations may be used only as outlined in the preceding text concerning "WSDOT's list for Suppliers - Manufacturers - Fabricators"

- Fabricated Precast Concrete Products
- Metal Fabrication (In Shop)

Definitions for the Scope of Work for prevailing wages may be found at the Washington State Department of Labor and Industries web site and in WAC Chapter 296-127.

WAC 296-127-018 Agency filings affecting this section

Coverage and exemptions of workers involved in the production and delivery of gravel, concrete, asphalt, or similar materials.

(1) The materials covered under this section include but are not limited to: Sand, gravel, crushed rock, concrete, asphalt, or other similar materials.

(2) All workers, regardless of by whom employed, are subject to the provisions of chapter 39.12 RCW when they perform any or all of the following functions:

(a) They deliver or discharge any of the above-listed materials to a public works project site:

(i) At one or more point(s) directly upon the location where the material will be incorporated into the project; or

(ii) At multiple points at the project; or

(iii) Adjacent to the location and coordinated with the incorporation of those materials.

(b) They wait at or near a public works project site to perform any tasks subject to this section of the rule.

(c) They remove any materials from a public works construction site pursuant to contract requirements or specifications (e.g., excavated materials, materials from demolished structures, clean-up materials, etc.).

(d) They work in a materials production facility (e.g., batch plant, borrow pit, rock quarry, etc.,) which is established for a public works project for the specific, but not necessarily exclusive, purpose of supplying materials for the project.

(e) They deliver concrete to a public works site regardless of the method of incorporation.

(f) They assist or participate in the incorporation of any materials into the public works project.

(3) All travel time that relates to the work covered under subsection (2) of this section requires the payment of prevailing wages. Travel time includes time spent waiting to load, loading, transporting, waiting to unload, and delivering materials. Travel time would include all time spent in travel in support of a public works project whether the vehicle is empty or full. For example, travel time spent returning to a supply source to obtain another load of material for use on a public works site or returning to the public works site to obtain another load of excavated material is time spent in travel that is subject to prevailing wage. Travel to a supply source, including travel from a public works site, to obtain materials for use on a private project would not be travel subject to the prevailing wage.

(4) Workers are not subject to the provisions of chapter 39.12 RCW when they deliver materials to a stockpile.

(a) A "stockpile" is defined as materials delivered to a pile located away from the site of incorporation such that the stockpiled materials must be physically moved from the stockpile and transported to another location on the project site in order to be incorporated into the project.

(b) A stockpile does not include any of the functions described in subsection (2)(a) through (f) of this section; nor does a stockpile include materials delivered or distributed to multiple locations upon the project site; nor does a stockpile include materials dumped at the place of incorporation, or adjacent to the location and coordinated with the incorporation.

(5) The applicable prevailing wage rate shall be determined by the locality in which the work is performed. Workers subject to subsection (2)(d) of this section, who produce such materials at an off-site facility shall be paid the applicable prevailing wage rates for the county in which the off-site facility is located. Workers subject to subsection (2) of this section, who deliver such materials to a public works project site shall be paid the applicable prevailing wage rates for the county in which the public works project is located.

[Statutory Authority: Chapter 39.12 RCW, RCW 43.22.051 and 43.22.270. 08-24-101, § 296-127-018, filed 12/2/08, effective 1/2/09. Statutory Authority: Chapters 39.04 and 39.12 RCW and RCW 43.22.270. 92-01-104 and 92-08-101, § 296-127-018, filed 12/18/91 and 4/1/92, effective 8/31/92.]

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Overtime Codes

Overtime calculations are based on the hourly rate actually paid to the worker. On public works projects, the hourly rate must be not less than the prevailing rate of wage minus the hourly rate of the cost of fringe benefits actually provided for the worker.

1. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.

B. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

C. The first two (2) hours after eight (8) regular hours Monday through Friday and the first ten (10) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other overtime hours and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

D. The first two (2) hours before or after a five-eight (8) hour workweek day or a four-ten (10) hour workweek day and the first eight (8) hours worked the next day after either workweek shall be paid at one and one-half times the hourly rate of wage. All additional hours worked and all worked on Sundays and holidays shall be paid at double the hourly rate of wage.

E. The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other hours worked Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

F. The first two (2) hours after eight (8) regular hours Monday through Friday and the first ten (10) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other overtime hours worked, except Labor Day, shall be paid at double the hourly rate of wage. All hours worked on Labor Day shall be paid at three times the hourly rate of wage.

G. The first ten (10) hours worked on Saturdays and the first ten (10) hours worked on a fifth calendar weekday in a four-ten hour schedule, shall be paid at one and one-half times the hourly rate of wage. All hours worked in excess of ten (10) hours per day Monday through Saturday and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

H. All hours worked on Saturdays (except makeup days if work is lost due to inclement weather conditions or equipment breakdown) shall be paid at one and one-half times the hourly rate of wage. All hours worked Monday through Saturday over twelve (12) hours and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

I. All hours worked on Sundays and holidays shall also be paid at double the hourly rate of wage.

J. The first two (2) hours after eight (8) regular hours Monday through Friday and the first ten (10) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked over ten (10) hours Monday through Saturday, Sundays and holidays shall be paid at double the hourly rate of wage.

K. All hours worked on Saturdays and Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at double the hourly rate of wage.

M. All hours worked on Saturdays (except makeup days if work is lost due to inclement weather conditions) shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

N. All hours worked on Saturdays (except makeup days) shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

Overtime Codes Continued

1. O. The first ten (10) hours worked on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays, holidays and after twelve (12) hours, Monday through Friday and after ten (10) hours on Saturday shall be paid at double the hourly rate of wage.

P. All hours worked on Saturdays (except makeup days if circumstances warrant) and Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at double the hourly rate of wage.

Q. The first two (2) hours after eight (8) regular hours Monday through Friday and up to ten (10) hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked in excess of ten (10) hours per day Monday through Saturday and all hours worked on Sundays and holidays (except Christmas day) shall be paid at double the hourly rate of wage. All hours worked on Christmas day shall be paid at two and one-half times the hourly rate of wage.

R. All hours worked on Sundays and holidays shall be paid at two times the hourly rate of wage.

S. The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays and all other overtime hours worked, except Labor Day, shall be paid at double the hourly rate of wage. All hours worked on Labor Day shall be paid at three times the hourly rate of wage.

U. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays (except Labor Day) shall be paid at two times the hourly rate of wage. All hours worked on Labor Day shall be paid at three times the hourly rate of wage.

V. All hours worked on Sundays and holidays (except Thanksgiving Day and Christmas day) shall be paid at one and one-half times the hourly rate of wage. All hours worked on Thanksgiving Day and Christmas day shall be paid at double the hourly rate of wage.

W. All hours worked on Saturdays and Sundays (except make-up days due to conditions beyond the control of the employer)) shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at double the hourly rate of wage.

X. The first four (4) hours after eight (8) regular hours Monday through Friday and the first twelve (12) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked over twelve (12) hours Monday through Saturday, Sundays and holidays shall be paid at double the hourly rate of wage. When holiday falls on Saturday or Sunday, the day before Saturday, Friday, and the day after Sunday, Monday, shall be considered the holiday and all work performed shall be paid at double the hourly rate of wage.

Y. All hours worked outside the hours of 5:00 am and 5:00 pm (or such other hours as may be agreed upon by any employer and the employee) and all hours worked in excess of eight (8) hours per day (10 hours per day for a 4 x 10 workweek) and on Saturdays and holidays (except labor day) shall be paid at one and one-half times the hourly rate of wage. (except for employees who are absent from work without prior approval on a scheduled workday during the workweek shall be paid at the straight-time rate until they have worked 8 hours in a day (10 in a 4 x 10 workweek) or 40 hours during that workweek.) All hours worked Monday through Saturday over twelve (12) hours and all hours worked on Sundays and Labor Day shall be paid at double the hourly rate of wage.

Z. All hours worked on Saturdays and Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid the straight time rate of pay in addition to holiday pay.

Overtime Codes Continued

2. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.

   B. All hours worked on holidays shall be paid at one and one-half times the hourly rate of wage.

   C. All hours worked on Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at two times the hourly rate of wage.

   F. The first eight (8) hours worked on holidays shall be paid at the straight hourly rate of wage in addition to the holiday pay. All hours worked in excess of eight (8) hours on holidays shall be paid at double the hourly rate of wage.

   G. All hours worked on Sunday shall be paid at two times the hourly rate of wage. All hours worked on paid holidays shall be paid at two and one-half times the hourly rate of wage including holiday pay.

   H. All hours worked on Sunday shall be paid at two times the hourly rate of wage. All hours worked on holidays shall be paid at one and one-half times the hourly rate of wage.

   O. All hours worked on Sundays and holidays shall be paid at one and one-half times the hourly rate of wage.

   R. All hours worked on Sundays and holidays and all hours worked over sixty (60) in one week shall be paid at double the hourly rate of wage.

   U. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked over 12 hours in a day or on Sundays and holidays shall be paid at double the hourly rate of wage.

   W. The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other hours worked Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage. On a four-day, ten-hour weekly schedule, either Monday thru Thursday or Tuesday thru Friday schedule, all hours worked after ten shall be paid at double the hourly rate of wage. The first eight (8) hours worked on the fifth day shall be paid at one and one-half times the hourly rate of wage. All other hours worked on the fifth, sixth, and seventh days and on holidays shall be paid at double the hourly rate of wage.

3. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.

   A. Work performed in excess of eight (8) hours of straight time per day, or ten (10) hours of straight time per day when four ten (10) hour shifts are established, or forty (40) hours of straight time per week, Monday through Friday, or outside the normal shift, and all work on Saturdays shall be paid at time and one-half the straight time rate. Hours worked over twelve hours (12) in a single shift and all work performed after 6:00 pm Saturday to 6:00 am Monday and holidays shall be paid at double the straight time rate of pay. Any shift starting between the hours of 6:00 pm and midnight shall receive an additional one dollar ($1.00) per hour for all hours worked that shift. The employer shall have the sole discretion to assign overtime work to employees. Primary consideration for overtime work shall be given to employees regularly assigned to the work to be performed on overtime situations. After an employee has worked eight (8) hours at an applicable overtime rate, all additional hours shall be at the applicable overtime rate until such time as the employee has had a break of eight (8) hours or more.

   C. Work performed in excess of eight (8) hours of straight time per day, or ten (10) hours of straight time per day when four ten (10) hour shifts are established, or forty (40) hours of straight time per week, Monday through Friday, or outside the normal shift, and all work on Saturdays shall be paid at one and one-half times the hourly rate of wage. All work performed after 6:00 pm Saturday to 5:00 am Monday and Holidays shall be paid at double the hourly rate of wage. After an employee has worked eight (8) hours at an applicable overtime rate, all additional hours shall be at the applicable overtime rate until such time as the employee has had a break of eight (8) hours or more.

Overtime Codes Continued

3. E. All hours worked Sundays and holidays shall be paid at double the hourly rate of wage. Each week, once 40 hours of straight time work is achieved, then any hours worked over 10 hours per day Monday through Saturday shall be paid at double the hourly wage rate.

F. All hours worked on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sunday shall be paid at two times the hourly rate of wage. All hours worked on paid holidays shall be paid at two and one-half times the hourly rate of wage including holiday pay.

H. All work performed on Sundays between March 16th and October 14th and all Holidays shall be compensated for at two (2) times the regular rate of pay. Work performed on Sundays between October 15th and March 15th shall be compensated at one and one half (1-1/2) times the regular rate of pay.

I. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. In the event the job is down due to weather conditions during a five day work week (Monday through Friday,) or a four day-ten hour work week (Tuesday through Friday,) then Saturday may be worked as a voluntary make-up day at the straight time rate. However, Saturday shall not be utilized as a make-up day when a holiday falls on Friday. All hours worked Monday through Saturday over twelve (12) hours and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

J. All hours worked between the hours of 10:00 pm and 5:00 am, Monday through Friday, and all hours worked on Saturdays shall be paid at a one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

4. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.

A. All hours worked in excess of eight (8) hours per day or forty (40) hours per week shall be paid at double the hourly rate of wage. All hours worked on Saturdays, Sundays and holidays shall be paid at double the hourly rate of wage.

B. All hours worked over twelve (12) hours per day and all hours worked on holidays shall be paid at double the hourly rate of wage.

C. On Monday through Friday, the first four (4) hours of overtime after eight (8) hours of straight time work shall be paid at one and one half (1-1/2) times the straight time rate of pay, unless a four (4) day ten (10) hour workweek has been established. On a four (4) day ten (10) hour workweek scheduled Monday through Thursday, or Tuesday through Friday, the first two (2) hours of overtime after ten (10) hours of straight time work shall be paid at one and one half (1-1/2) times the straight time rate of pay. On Saturday, the first twelve (12) hours of work shall be paid at one and one half (1-1/2) times the straight time rate of pay, except that if the job is down on Monday through Friday due to weather conditions or other conditions outside the control of the employer, the first ten (10) hours on Saturday may be worked at the straight time rate of pay. All hours worked over twelve (12) hours in a day and all hours worked on Sunday and Holidays shall be paid at two (2) times the straight time rate of pay.

Overtime Codes Continued

4. D. All hours worked in excess of eight (8) hours per day or forty (40) hours per week shall be paid at double the hourly rate of wage. All hours worked on Saturday, Sundays and holidays shall be paid at double the hourly rate of pay. Rates include all members of the assigned crew.

EXCEPTION:
On all multipole structures and steel transmission lines, switching stations, regulating, capacitor stations, generating plants, industrial plants, associated installations and substations, except those substations whose primary function is to feed a distribution system, will be paid overtime under the following rates:

The first two (2) hours after eight (8) regular hours Monday through Friday of overtime on a regular workday, shall be paid at one and one-half times the hourly rate of wage. All hours in excess of ten (10) hours will be at two (2) times the hourly rate of wage. The first eight (8) hours worked on Saturday will be paid at one and one-half (1-1/2) times the hourly rate of wage. All hours worked in excess of eight (8) hours on Saturday, and all hours worked on Sundays and holidays will be at the double the hourly rate of wage.

All overtime eligible hours performed on the above described work that is energized, shall be paid at the double the hourly rate of wage.

E. The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other hours worked Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

On a four-day, ten-hour weekly schedule, either Monday thru Thursday or Tuesday thru Friday schedule, all hours worked after ten shall be paid at double the hourly rate of wage. The Monday or Friday not utilized in the normal four-day, ten hour work week, and Saturday shall be paid at one and one half (1½) times the regular shift rate for the first eight (8) hours. All other hours worked Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

F. All hours worked between the hours of 6:00 pm and 6:00 am, Monday through Saturday, shall be paid at a premium rate of 20% over the hourly rate of wage. All hours worked on Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at double the hourly rate of wage.

G. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked Monday through Saturday over twelve (12) hours and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

H. The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other overtime hours worked, except Labor Day, and all hours on Sunday shall be paid at double the hourly rate of wage. All hours worked on Labor Day shall be paid at three times the hourly rate of wage.

Holiday Codes

5. A. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, and Christmas Day (7).

B. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, the day before Christmas, and Christmas Day (8).

C. Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8).

Holiday Codes Continued

5. D. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8).

H. Holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, the Day after Thanksgiving Day, And Christmas (6).

I. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day (6).

J. Holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, Friday after Thanksgiving Day, Christmas Eve Day, And Christmas Day (7).

K. Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday After Thanksgiving Day, The Day Before Christmas, And Christmas Day (9).

L. Holidays: New Year's Day, Martin Luther King Jr. Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, And Christmas Day (8).

N. Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, The Friday After Thanksgiving Day, And Christmas Day (9).

P. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday And Saturday After Thanksgiving Day, The Day Before Christmas, And Christmas Day (9). If A Holiday Falls On Sunday, The Following Monday Shall Be Considered As A Holiday.

Q. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day (6).

R. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Day After Thanksgiving Day, One-Half Day Before Christmas Day, And Christmas Day. (7 1/2).

S. Paid Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, And Christmas Day (7).

T. Paid Holidays: New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, The Friday After Thanksgiving Day, Christmas Day, And The Day Before Or After Christmas (9).

Z. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8).

6. A. Paid Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8).

E. Paid Holidays: New Year's Day, Day Before Or After New Year's Day, Presidents Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and a Half-Day On Christmas Eve Day. (9 1/2).

G. Paid Holidays: New Year's Day, Martin Luther King Jr. Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and Christmas Eve Day (11).

Holiday Codes Continued

6. H. Paid Holidays: New Year's Day, New Year's Eve Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday After Thanksgiving Day, Christmas Day, The Day After Christmas, And A Floating Holiday (10).

I. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday After Thanksgiving Day, And Christmas Day (7).

T. Paid Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, The Friday After Thanksgiving Day, The Last Working Day Before Christmas Day, And Christmas Day (9).

Z. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, And Christmas Day (7). If a holiday falls on Saturday, the preceding Friday shall be considered as the holiday. If a holiday falls on Sunday, the following Monday shall be considered as the holiday.

7. A. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8). Any Holiday Which Falls On A Sunday Shall Be Observed As A Holiday On The Following Monday. If any of the listed holidays falls on a Saturday, the preceding Friday shall be a regular work day.

B. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

C. Holidays: New Year's Day, Martin Luther King Jr. Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

D. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8). Unpaid Holidays: President's Day. Any paid holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any paid holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

E. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

F. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, the last working day before Christmas day and Christmas day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

G. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day (6). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday.

H. Holidays: New Year's Day, Martin Luther King Jr. Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, the Last Working Day before Christmas Day and Christmas Day (9). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

Holiday Codes Continued

7. I. Holidays: New Year's Day, President's Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day, The Friday After Thanksgiving Day, The Day Before Christmas Day And Christmas Day (9). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

J. Holidays: New Year's Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day and Christmas Day (6). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

K. Holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

L. Holidays: New Year's Day, Memorial Day, Labor Day, Independence Day, Thanksgiving Day, the Last Work Day before Christmas Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

M. Paid Holidays: New Year's Day, The Day after or before New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, And the Day after or before Christmas Day (10). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

N. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. When Christmas falls on a Saturday, the preceding Friday shall be observed as a holiday.

P. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday.

Q. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, the Last Working Day before Christmas Day and Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. If any of the listed holidays falls on a Saturday, the preceding Friday shall be a regular work day.

R. Paid Holidays: New Year's Day, the day after or before New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and the day after or before Christmas Day (10). If any of the listed holidays fall on Saturday, the preceding Friday shall be observed as the holiday. If any of the listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly.

S. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, Christmas Day, the Day after Christmas, and A Floating Holiday (9). If any of the listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly.

Holiday Codes Continued

T. Paid Holidays: New Year's Day, the Day after or before New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and The Day after or before Christmas Day. (10). If any of the listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

Note Codes

8. D. Workers working with supplied air on hazmat projects receive an additional $1.00 per hour.

L. Workers on hazmat projects receive additional hourly premiums as follows -Level A: $0.75, Level B: $0.50, And Level C: $0.25.

M. Workers on hazmat projects receive additional hourly premiums as follows: Levels A & B: $1.00, Levels C & D: $0.50.

N. Workers on hazmat projects receive additional hourly premiums as follows -Level A: $1.00, Level B: $0.75, Level C: $0.50, And Level D: $0.25.

P. Workers on hazmat projects receive additional hourly premiums as follows -Class A Suit: $2.00, Class B Suit: $1.50, Class C Suit: $1.00, And Class D Suit $0.50.

Q. The highest pressure registered on the gauge for an accumulated time of more than fifteen (15) minutes during the shift shall be used in determining the scale paid.

R. Effective August 31, 2012 – A Traffic Control Supervisor shall be present on the project whenever flagging or spotting or other traffic control labor is being utilized. A Traffic Control Laborer performs the setup, maintenance and removal of all temporary traffic control devices and construction signs necessary to control vehicular, bicycle, and pedestrian traffic during construction operations. Flaggers and Spotters shall be posted where shown on approved Traffic Control Plans or where directed by the Engineer. All flaggers and spotters shall possess a current flagging card issued by the State of Washington, Oregon, Montana, or Idaho. These classifications are only effective on or after August 31, 2012.

S. Effective August 31, 2012 – A Traffic Control Supervisor shall be present on the project whenever flagging or spotting or other traffic control labor is being utilized. Flaggers and Spotters shall be posted where shown on approved Traffic Control Plans or where directed by the Engineer. All flaggers and spotters shall possess a current flagging card issued by the State of Washington, Oregon, Montana, or Idaho. This classification is only effective on or after August 31, 2012.

T. Effective August 31, 2012 – A Traffic Control Laborer performs the setup, maintenance and removal of all temporary traffic control devices and construction signs necessary to control vehicular, bicycle, and pedestrian traffic during construction operations. Flaggers and Spotters shall be posted where shown on approved Traffic Control Plans or where directed by the Engineer. All flaggers and spotters shall possess a current flagging card issued by the State of Washington, Oregon, Montana, or Idaho. This classification is only effective on or after August 31, 2012.

Note Codes Continued

8. U. Workers on hazmat projects receive additional hourly premiums as follows – Class A Suit: $2.00, Class B Suit: $1.50, And Class C Suit: $1.00. Workers performing underground work receive an additional $0.40 per hour for any and all work performed underground, including operating, servicing and repairing of equipment. The premium for underground work shall be paid for the entire shift worked. Workers who work suspended by a rope or cable receive an additional $0.50 per hour. The premium for work suspended shall be paid for the entire shift worked. Workers who do “pioneer” work (break open a cut, build road, etc.) more than one hundred fifty (150) feet above grade elevation receive an additional $0.50 per hour.

V. In addition to the hourly wage and fringe benefits, the following depth and enclosure premiums shall be paid. The premiums are to be calculated for the maximum depth and distance into an enclosure that a diver reaches in a day. The premiums are to be paid one time for the day and are not used in calculating overtime pay.

Depth premiums apply to depths of fifty feet or more. Over 50' to 100' - $2.00 per foot for each foot over 50 feet. Over 101' to 150' - $3.00 per foot for each foot over 101 feet. Over 151' to 220' - $4.00 per foot for each foot over 220 feet. Over 221' - $5.00 per foot for each foot over 221 feet.

Enclosure premiums apply when divers enter enclosures (such as pipes or tunnels) where there is no vertical ascent and is measured by the distance travelled from the entrance. 25’ to 300’ - $1.00 per foot from entrance. 300’ to 600’ - $1.50 per foot beginning at 300’. Over 600’ - $2.00 per foot beginning at 600’.

W. Meter Installers work on single phase 120/240V self-contained residential meters. The Lineman/Groundmen rates would apply to meters not fitting this description.

Appendix B

AMEC Geotechnical Report

GEOTECHNICAL ENGINEERING REPORT
TULALIP TRIBE WASTEWATER TREATMENT FACILITIES
TULALIP, WASHINGTON

Submitted to:

Tulalip Tribe c/o
Parametrix, Inc.
PO Box 460
Sumner, Washington 98390-1516

Submitted by:

AMEC Earth & Environmental, Inc.
11335 N.E. 122nd Way, Suite 100
Kirkland, Washington 98034-6918

January 11, 2002

1-91M-13845-A

January 11, 2002
1-91M-13845-A

Tulalip Tribe c/o
Parametrix, Inc.
PO Box 460
Sumner, Washington 98390-1516

Attention: Mr. Mike Ollivant

Subject: **Geotechnical Engineering Report**
Tulalip Tribe Wastewater Treatment Facilities
Tulalip, Washington

Dear Mike:

AMEC Earth & Environmental, Inc. (AMEC) is pleased to submit this report describing our geotechnical engineering evaluation for the above-referenced project. The purpose of our evaluation was to derive design conclusions and recommendations concerning site preparation, excavations, foundations, floors, drainage, pavement sections, and structural fill.

Authorization to perform these services was provided in your Subconsultant Agreement for Parametrix Project No. 216-1598-012, signed by us on November 26, 2001. This report has been prepared for the exclusive use of Tulalip Tribe and their consultants, for specific application to this project, in accordance with generally accepted geotechnical engineering practice.

We appreciate the opportunity to be of service on this project and would be happy to answer any questions you may have.

Sincerely,

AMEC Earth & Environmental, Inc.

James S. Dransfield, P.E.
Principal

TMM/JSD/kms

Distribution: Mr. Mike Ollivant, Parametrix, Inc. (3)

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Appendix B — Laboratory Testing Procedures and Results

1.0 SUMMARY

The following summary of project geotechnical considerations is presented for introductory purposes and, as such, should be used only in conjunction with the full text of this report.

- Project Description: Development plans call for constructing a new wastewater treatment plant at the project site with associated asphalt-paved roads. We anticipate that the basins will impose moderate foundation loads, while buildings will impose relatively low foundation loads.

- Exploratory Methods: We explored subsurface conditions by means of advancing 14 test pits and 2 borings and installing one 20-foot piezometer. The test pits were advanced at strategic locations across the project site to depths ranging from about 5 to 10 feet below existing grades, and the borings were drilled to depths of 39 feet.

- Soil Conditions: Soils underlying the site generally consist of topsoil/duff overlying fine to medium sand with some silt which grades to a fine silty sand below 35 feet.

- Groundwater Conditions: All of our explorations encountered groundwater or seepage at depths ranging from 1½ to 7 feet below existing grades. Static water levels in the piezometer varied between 3½ and 6½ feet below ground surface (fall/early winter 2001). Because our explorations were performed during an extended period of generally wet weather, the groundwater conditions present at that time may closely represent the yearly high levels; somewhat lower levels probably occur during the summer and early fall months.

- Liquefaction Considerations: Our liquefaction analysis indicated that the upper loose sand soils underlying the project site are susceptible to liquefaction during a severe earthquake. Mitigation measures appear warranted for the proposed development to reduce the risk of surface settlements and damage.

  AMEC recommends mitigating the liquefaction hazard by means of overexcavation of the loose, liquefaction-susceptible soils and replacement with compacted structural fill. Depending on settlement tolerance, the overexcavation depths would range from 3 to 7 feet.

- On-Site Soil Considerations: Ideally, earthwork would be scheduled for the summer and fall months, when drier weather will maximize the potential for reusing on-site soils and when groundwater levels will likely be at their seasonal low.

2.0 SITE AND PROJECT DESCRIPTION

The project site is an undeveloped lot located in the Tulalip Indian Reservation, Washington, as shown on the enclosed *Location Map* (Figure 1). The project site consists of a roughly rectangular parcel that measures about 490 by 190 feet overall and encompasses approximately 2 acres. Site boundaries are generally delineated by a PUD road on the north and by undeveloped land on the south, east, and west. The enclosed *Site & Exploration Plan* (Figure 2) illustrates these site boundaries and adjacent existing features.

Development plans call for constructing a new wastewater treatment plant at the project site. According to drawings prepared by Parametrix, this facility will comprise eight basins, four pipe galleries, a headworks area, a mechanical room, an electrical and control room, an effluent building, and an office building with associated asphalt-paved roads. We anticipate that the basins and headworks will impose moderate to high foundation loads, while the buildings will be relatively light. The enclosed *Site & Exploration Plan* (Figure 2) illustrates the proposed locations of these structures.

The conclusions and recommendations contained in this report are based on our understanding of the currently proposed utilization of the project site, as derived from layout drawings, written information, and verbal information supplied to us. Consequently, if any changes are made in the currently proposed project, we may need to modify our conclusions and recommendations contained herein to reflect those changes.

3.0 EXPLORATORY METHODS

We explored surface and subsurface conditions at the project site during November 2001. Our exploration and testing program comprised the following elements:

- A visual surface reconnaissance of the site;
- Fourteen test pits (designated FTP-15 through FTP-19"I"), advanced across the site;
- Two borings (designated B-8 and B-9), within the footprint of the basins;
- One piezometer/well (designated P-9), advanced at on the west side of the site;
- Two grain size analyses, performed on selected soil samples obtained from borings B-8 and B-9;
- A review of published geologic and seismologic maps and literature.

Figure 2 depicts the approximate relative locations of AMEC's subsurface explorations. Appendix A of this report describes our field exploration procedures, and Appendix B describes our laboratory testing procedures.

The specific number, locations, and depths of our explorations, and piezometers were selected by Parametrix and field-adjusted by AMEC in relation to the existing and proposed site features, under the constraints of surface access, underground utility conflicts, and budget considerations. No topographic information was available at the time of our study and a surveyed plan of the boring, test pit, and well locations was not available when this report was issued. Surface and groundwater elevations at our boring, test pit, and well locations will be provided at a later date.

It should be realized that the explorations performed and utilized for this evaluation reveal subsurface conditions only at discrete locations across the project site and that actual conditions in other locations could vary. Furthermore, the nature and extent of any such variations would not become evident until additional explorations are performed or until construction activities have begun. If significant variations are observed at that time, we may need to modify our conclusions and recommendations contained in this report to reflect the actual site conditions.

4.0 SITE CONDITIONS

The following sections of text present our observations, measurements, findings, and interpretations regarding surface, soil, groundwater, and seismic conditions at the project site.

4.1 Surface Conditions

The proposed building footprint lies within an area where the regional topography is characterized by generally flat conditions with some minor undulating topography. The subject site has gently undulating topography with topographic relief on the order of 3 feet across the site. Numerous, small closed depressions were also observed across the site. Some standing water was noted immediately west of the subject site within the cleared, grass-covered field. Large puddles were also noted within the PUD access road near the northwest corner of the subject site.

Recently the subject site had been cleared, removing all of the vegetation. However, the site had not been grubbed, thus abundant organic debris consisting of stumps, roots, and woody debris mantled the surface. The eastern edge of the subject site had been stripped of topsoil and majority of roots for an access roadway.

4.2 Soil Conditions

According to published geologic maps, soil conditions in the site vicinity are characterized by loose to medium-dense sands (referred to as the Marysville Sand Member of the Vashon recessional outwash Formation). These deposits are typified by clean sand with some interbeds of silt and clay. The Marysville sand typically grades finer towards the south, with silt and clay common in the vicinity of the city of Marysville. The Marysville Sand is believed to vary in thickness from 3 feet on the eastern and western sides of the valley, up to possibly 90 feet within the center of the valley. The sand mantles glacially overridden deposits consisting of silty sands and gravels (glacial till) and of silts and sandy silts at depth.

Our on-site explorations revealed fairly uniform near-surface soil conditions and confirmed the mapped stratigraphy. In general, our explorations encountered approximately 8-inches of topsoil/ duff across the site, although test pits FTP-16, 19B, 19C and 19G encountered between 10 and 24-inches of topsoil/duff. Immediately beneath the topsoil/duff, loose, fine to medium sand with some silt and silty sand were encountered to depths of approximately 1 to 7 feet. Beneath the aforementioned soil horizons, medium dense to dense, gray, fine to medium sand with trace to some silt was generally encountered to the full depths explored within the test pits (approximately 5 to 10 feet) and to depths on the order of 22 feet within borings B-8 and B-9. Boring P-9 disclosed the fine to medium sand to extend to a depth of approximately 15 feet. Within all the borings the soils generally graded to silty, fine sand below the fine to medium sand.

The enclosed exploration logs provide a detailed description of the soil strata encountered in our subsurface explorations. Table 1 summarizes the approximate thicknesses and depths of selected soil layers.

TABLE 1
APPROXIMATE THICKNESSES AND DEPTHS OF SOIL LAYERS ENCOUNTERED IN EXPLORATIONS

Exploration	Thickness of Topsoil/Duff (inches)	Thickness of Loose Silty Fine Sand/Fine Sand with some silt (feet)	Interpreted Depth to Medium Dense Sand (feet)
B-8	8	2	3
B-9	8	6½	7
P-9	12	2	3
FTP-15	8	1½	2
FTP-16	10	2½	3
FTP-17	8	3	3½
FTP-18	8	1½	2
FTP-19	8	3	3½
FTP-19A	12	1	2
FTP-19B	18	1	2½
FTP-19C	10	2½	3
FTP-19D	8	2	2½
FTP-19E	8	1	1½
FTP-19F	8	1	1½
FTP-19G	9	1	1½
FTP-19H	6	1	1½
FTP-19I	24	1½	3½

N/E = not encountered within depth of exploration
G/S = exposed at ground surface.

Our geotechnical laboratory tests revealed that the relatively clean sands have fines (silt and clay) content on the order of 5 to 9 percent, and a moisture content on the order of 26 percent. We interpret these soils to be currently above their optimum moisture contents, and to be moderately sensitive to moisture content variations. The enclosed laboratory testing sheets graphically present our test results, and Table 2 summarizes these results.

TABLE 2
LABORATORY TEST RESULTS FOR NON-ORGANIC ON-SITE SOILS

Soil Type And Source	Sample Depth (feet)	Moisture Content (percent)	Gravel Content (percent)	Sand Content (percent)	Silt/Clay Content (percent)
Fine SAND/ B-8	22½	25.8	0	90.6	9.4
SAND w/some silt/ B-9	2½	26.4	0.2	94.9	4.9

N/T = not tested

4.3 Groundwater Conditions

At the time of our exploration program (November and December 2001), all of our explorations encountered groundwater and seepage, at depths ranging from 1½ to 7 feet below existing grades. Within piezometer P-9 the groundwater table was measured at 6.5 feet, rising to 3.5 feet in mid-December. We would interpret the shallower seepage (at 1½ feet) to be locally perched water. Table 3 summarizes the approximate groundwater depths and elevations that we measured in our explorations and observation wells. Because our explorations were performed during an extended period of generally wet weather, the groundwater conditions present at that time may closely represent the yearly high levels; somewhat lower levels probably occur during the summer and early fall months. Throughout the year, groundwater levels would likely fluctuate in response to changing precipitation patterns, off-site construction activities, and site utilization.

TABLE 3
APPROXIMATE DEPTHS OF GROUNDWATER ENCOUNTERED IN EXPLORATIONS

Exploration	Depth of Groundwater (feet)	Date of Measurement
B-8	6	12/7/2001
B-9	6	12/7/2001
P-9	6.5	11/20/2001
P-9	5.3	12/3/2001
P-9	3.5	12/18/2001
TP-15	4	11/29/2001
TP-16	3.5	11/29/2001
TP-17	1.5	11/29/2001
TP-18	4	11/29/2001
TP-19	7	11/29/2001
TP-19A	4	11/29/2001
TP-19B	6	11/29/2001
TP-19C	6	11/29/2001
TP-19D	7	11/29/2001
TP-19E	N/E	11/29/2001
TP-19F	5	11/29/2001
TP-19G	5	11/29/2001
TP-19H	5	11/29/2001
TP-19I	6.5	11/29/2001

Note—With the exception of well at P-9, all groundwater levels were measured at time of exploration.
N/E = not encountered within depth of exploration

4.4 Seismic Conditions

Based on our analysis of subsurface exploration logs and our review of published geologic maps, we interpret the on-site soil conditions to correspond to seismic soil profile type S-D as defined by Table 16-J of the 1997 *Uniform Building Code.* Current (1996) *National Seismic Hazard Maps* prepared by the U.S. Geological Survey indicate that a peak bedrock site acceleration coefficient of about 0.27g is appropriate for an earthquake having a 10-percent probability of exceedance in 50 years (corresponding to a return interval of 475 years). According to Figure 16-2 of the 1997 *Uniform Building Code*, the site lies within seismic risk zone 3.

5.0 LIQUEFACTION ANALYSIS

Liquefaction is a sudden increase in porewater pressure and a sudden loss of soil shear strength caused by shear strains, as could result from an earthquake. Research has shown that saturated, loose sands with a fines (silt and clay) content less than about 25 percent are most susceptible to liquefaction. Although other soil types are generally considered to have a low susceptibility, liquefaction may still occur during a strong earthquake. Our on-site subsurface explorations revealed saturated (or potentially saturated), loose and medium dense sands. To evaluate the possibility that the on-site, native sands could liquefy during a seismic event, we performed a liquefaction analysis based on these site conditions.

For purposes of evaluating liquefaction potential, we used two model earthquakes to simulate differing seismic conditions. The first model represents a moderate earthquake with a statistical recurrence interval, or return period, of 100 years; the second model represents a strong earthquake with a return period of 475 years. According to published seismic maps, these return periods roughly correspond with the following magnitudes and peak ground surface accelerations:

Return Period	Magnitude	Peak Acceleration
100 years	6.5	0.15 g
475 years	7.5	0.27 g

Using these parameters, we applied an analysis method developed by Seed and others (1983) to determine the factor of safety against liquefaction for the loose and medium dense sand layers underlying the site vicinity. A safety factor less than 1.0 indicates a high potential for liquefaction, whereas a safety factor greater than 1.5 is generally considered to indicate a low potential; safety factors between 1.0 and 1.5 roughly correspond to a moderate potential. AMEC recommends a factor of safety greater than 1.5 for this site. The following table presents the results of our liquefaction analysis.

	Depth to Safety Factor > 1.5	
Boring number	100 – year	475 – year
B-8	3 feet	5 feet
B-9	7 feet	7 feet
P-9	3 feet	3 feet

After calculating the safety factors, we evaluated the risk of on-site surface damage resulting from liquefaction of the upper native sands. Surface damage could include subsidence, fissuring, or heaving of the ground surface, thereby causing settling, cracking, or tilting of buildings and other structures. Our analysis indicated that up to 2 inches of settlement is probable in the event of a 475-year earthquake and that up to 1½ inches of settlement is probable in the event of a 100-year earthquake.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Development plans call for construction of a new wastewater treatment facility at the project site. We offer the following general geotechnical conclusions and recommendations concerning this project.

- Feasibility: Based on our field explorations, research, and analyses, the proposed basins and related structures appear feasible from a geotechnical standpoint, contingent on the recommendations presented herein.

- Building Foundation Options: In our opinion, the proposed building structures can be supported by conventional spread footings that bear on medium dense, native sands or on compacted structural fill, contingent on proper subgrade preparation. If the footings are not founded on medium dense, native sands, then subgrade soils should be overexcavated to medium dense material and replaced with compacted structural fill.

- Floor Options: Soil conditions are amenable to the use of a soil-supported slab-on-grade floor, contingent on proper subgrade preparation.

- Basin Foundation Options: In our opinion, the proposed basin structures can be supported by mat foundations that bear on medium dense, native sands or on compacted structural fill, contingent on proper subgrade preparation and mitigation for liquefaction.

- Liquefaction Considerations: Our liquefaction analysis indicated that the upper loose sand soils underlying the project site are susceptible to liquefaction during a severe earthquake. Mitigation measures appear warranted for the proposed development to reduce the risk of surface settlements and damage.

  AMEC recommends mitigating the liquefaction hazard by means of overexcavation of the loose, liquefaction-susceptible soils down to medium dense soils, and replacement with compacted structural fill. Based on our explorations and analysis, we recommend excavations ranging from 3 to 7 feet below ground surface (see Site Excavations, Section 6.1).

- Fills in Below-Groundwater Excavations: Depending on the depth and time of year, the base of the remedial overexcavations made for liquefaction mitigation may be at or below the static groundwater table. Even with proper dewatering, some standing water may accumulate in the base of these cuts. In such areas, a heavier crushed rock, such as "Quarry Spalls", per WSDOT 9-13.6 may be needed to stabilize the base of the excavation, prior to subsequent filling above the water surface.

- Seismic Considerations: Based on our literature review and subsurface interpretations, we recommend that the project structural engineer use the following seismic parameters for design of buildings, retaining walls, and other site structures, as appropriate.

Design Parameter	Value
Acceleration Coefficient (1996 USGS)	0.27g
Risk Zone (UBC)	3
Soil Profile Type (1997 UBC)	S-D

- On-Site Soil Reuse: Our visual soil classifications and laboratory testing indicate that some of the on-site soils are moderately moisture-sensitive and susceptible to disturbance when wet. In order to maximize the potential for reusing on-site soils as structural fill, earthwork should be scheduled for periods of dry weather, such as usually occur during the summer and early fall months.

- Subgrade Protection: Due to the moisture-sensitive nature of the on-site soils, the contractor should install appropriate temporary drainage systems to keep water out of the construction areas, and should minimize traffic over any subgrades prepared within these soils.

The following text sections of this report present our specific geotechnical conclusions and recommendations concerning site preparation, excavations, foundations, floors, drainage, pavement sections, and structural fill. ASTM specification codes cited herein refer to the current American Society for Testing and Materials manual. WSDOT specification codes and plan designations cited herein refer to WSDOT publications M41-10, *2000 Standard Specifications for Road, Bridge, and Municipal Construction*, and M21-01, *Standard Plans for Road, Bridge, and Municipal Construction*, respectively.

6.1 Site Preparation

Preparation of the project site should involve temporary drainage, clearing, stripping, excavations, filling, erosion control, dewatering, and subgrade compaction. The paragraphs below discuss our geotechnical comments and recommendations concerning site preparation.

Temporary Drainage: We recommend intercepting and diverting any potential sources of surface or near-surface water within the construction zones before stripping begins. Because the selection of an appropriate drainage system will depend on the water quantity, season, weather conditions, construction sequence, and contractor's methods, final decisions regarding drainage systems are best made in the field at the time of construction. Nonetheless, we anticipate that curbs, berms, or ditches placed around the work areas will adequately intercept surface water runoff.

Clearing and Stripping: After surface and near-surface water sources have been controlled, the construction areas should be cleared and stripped of all trees, bushes, sod, topsoil, debris, asphalt,

and concrete. Our explorations indicate that an average thickness of about 8 to 36 inches of sod, duff, and topsoil will be encountered across the site, but significant variations could exist.

Erosion Control Measures: Because stripped surfaces and soil stockpiles are typically a source of runoff sediments, they should be given particular attention. If earthwork occurs during wet weather, we recommend that all stripped surfaces be covered with straw to reduce runoff erosion. Similarly, soil stockpiles and cut slopes should be covered with plastic sheeting for erosion protection. We also recommend that a staked silt fence be installed around the area to be disturbed. The base of the silt fence should be buried so that sediment cannot pass beneath it, and the silt fence should be inspected and maintained during the time that the site soils are exposed, on a periodic basis, and after any major rainstorm event. It may be prudent to maintain a berm and swale around the downslope side of stripped areas and stockpiles in order to capture runoff water and thereby reduce the downslope sediment transport. In addition, the stripped areas should be revegetated as soon as possible, also reducing the potential for erosion.

Site Excavations: Remedial overexcavation of the loose sands down to medium dense soil, and replacement with compacted structural fill is recommended to mitigate for liquefaction-induced settlements. Based on our explorations, the upper loose sands range from 1-1/2 to 7 feet in maximum thickness. For settlement-sensitive structures, we recommend overexcavation to 7 feet below ground surface for liquefaction mitigation. Less overexcavation may be required in some areas to reach medium dense soils. However, this would need to be verified by a geotechnical engineer at the time of construction. At a minimum, we recommend overexcavation to 3 feet below ground surface for all areas requiring liquefaction mitigation.

If some portions of the facility are more settlement-tolerant, only partial overexcavation could be considered. The estimated liquefaction-induced settlement will depend on the thickness of loose sand that remains beneath site facilities (pavement, slabs, foundations, utilities). These settlements are summarized below (assuming the depth to medium dense soil is 7 feet):

Thickness of Loose Sand Beneath Facility (feet)	Estimated Liquefaction-Induced Settlement
7 feet	2 inches
3 feet	1 inches
0 feet	0 inches

Where the base of the resulting excavation is in a drained condition, we recommend static rolling (no vibration) to a firm and unyielding condition. Depending on the depth and time of year, the base of the remedial overexcavations made for liquefaction mitigation may be at or below the static groundwater table. Even with proper dewatering, some standing water may accumulate in the base of these cuts. In such areas, a heavier crushed rock, such as "Quarry Spalls", per WSDOT 9-13.6 may be needed to stabilize the base of the excavation and to raise the fill level above the water surface prior to subsequent filling.

Wood debris was observed within the fill material encountered during installation of piezometer P-9. Although our explorations did not reveal rubble within the fill soils or boulders within the native soils, such obstacles could be present at random locations within these deposits.

Dewatering: Our explorations encountered groundwater at depths ranging from 1½ to 7 feet below grade at the time of drilling, but static water levels in piezometer P-9 ranged from 3.5 to 6.5 feet below ground surface. Consequently, site excavations might extend below the groundwater level, depending on the actual excavation depth and time of year. If groundwater is encountered, we anticipate that an internal system of ditches, sumpholes, and pumps or an external system of wellpoints will be needed to dewater the excavation, depending on the quantities of water encountered. An experienced dewatering contractor should design such an external system, if needed, after being allowed to review our exploration logs.

Temporary Cut Slopes: All temporary cut slopes associated with site regrading or excavations should be adequately inclined to prevent sloughing and collapse. For the upper soil layers that will likely be exposed in on-site cuts, we tentatively recommend a maximum cut slope inclination of 1½H:1V. However, appropriate inclinations will ultimately depend on the actual soil conditions exposed during earthwork. If the soils are not dewatered, the resulting cut slopes would be flatter.

Subgrade Compaction: Exposed subgrades for footings, floors, pavements, and other structures should be compacted with a vibratory roller to a firm, unyielding state. Any localized zones of loose granular soils observed within a subgrade should be compacted to a density commensurate with the surrounding soils. In contrast, any organic, soft, or pumping soils observed within a subgrade should be overexcavated and replaced with a suitable structural fill material.

Site Filling: We anticipate that significant fills will be required to bank fill overexcavations for liquefaction mitigation. Outside of the footprint of the major facilities, we anticipate minor filling in the topographically low areas of the site, to achieve design subgrades for the new facility. Our conclusions regarding the reuse of on-site soils and our comments regarding wet-weather filling are presented below. More details regarding structural fill placement and compaction are presented in Section 6.7 of this report.

On-Site Soils: We offer the following evaluation of these on-site soils in relation to potential use as structural fill.

- *Surficial Organic Soils*: The sod, duff, topsoil, and organic-rich soils mantling most of the site are *not* suitable for use as structural fill under any circumstances, due to their long-term compressibility. Consequently, these materials can be used only for non-structural purposes, such as in landscaping areas.

- *Sands*: The relatively clean sands underlying the site appear suitable for reuse as structural fill. However, the wet and saturated soils may need to be aerated to reduce their moisture content.

- *Silty Sands and Sandy Silts*: The silty sands and sandy silts underlying the surficial organic soils do not appear suitable for reuse as structural fill at their present moisture contents. However, these soils may become suitable for reuse during a period of dry weather if they can be aerated to reduce their moisture content.

Wet-Weather Considerations: As discussed above, some of the on-site soils would be difficult to reuse as structural fill during wet weather. Consequently, the project specifications should include provisions for using imported, clean, granular fill in case site filling must proceed during wet weather. For general structural fill purposes, we recommend using a well-graded sand and gravel, such as "Shoulder Ballast" or "Gravel Backfill for Drains" per WSDOT: 9-03.9(2) and 9-03.12(4), respectively.

Permanent Slopes: All permanent cut slopes and fill slopes should be adequately inclined to minimize long-term raveling, sloughing, and erosion. We generally recommend that no slopes be steeper than 2H:1V, but cut slopes in glacial till and similarly coherent soils can be inclined as steep as 1H:1V if appearance is not a concern. For all soil types, the use of flatter slopes (such as 3H:1V) would further reduce long-term erosion and facilitate revegetation.

Slope Protection: We recommend that a permanent berm, swale, or curb be constructed along the top edge of all permanent slopes to intercept surface flow. Also, a hardy vegetative groundcover should be established as soon as feasible, to further protect the slopes from runoff water erosion. Alternatively, permanent slopes could be armored with quarry spalls or a geosynthetic erosion mat.

6.2 Spread Footings

In our opinion, the proposed building structures can be supported by conventional spread footings that bear on medium dense, native sands or on compacted structural fill. If the footings are not to be founded on medium dense, native sands, then subgrade soils should be overexcavated to medium dense material and replaced with compacted structural fill.

Footing Depths and Widths: For frost and erosion protection, the bottoms of all exterior footings should bear at least 18 inches below adjacent outside grades, whereas the bottoms of interior footings need bear only 12 inches below the surrounding slab surface level. However, greater depths would be needed for liquefaction mitigation, as discussed previously in Section 6.1.

Bearing Subgrades: The loose soils underlying the proposed building footprints are not well-suited for supporting spread footings, due to their moderately high compressibility and susceptibility to liquefaction. In order to provide adequate bearing conditions for spread footings, we recommend that all footings gain support from the medium dense sands and silty sands, which generally lie at depths on the order of 3 to 7 feet below existing grades. While suitable bearing for static design may be achieved at shallower depths in some portions of the site, excavation to 3 to 7 feet is described in Section 6.1 to reduce the risk of liquefaction-induced settlement. Where the bearing horizon depth exceeds the minimum footing depth required for liquefaction mitigation, adequate support can be accomplished by either (1) extending all footings downward to bear on native,

medium dense sands and/or silty sands or (2) overexcavating to this bearing horizon depth and replacing the overlying soils with bearing pads of suitable structural fill.

Bearing Pad Materials: We recommend that bearing pads for all footings be composed of well-graded sands and gravels, such as "Gravel Borrow" per WSDOT Standard Specification 9-03.14(1), or uniformly graded crushed rock, such as "Crushed Surfacing Base Course" per WSDOT standard Specification 9-03.9(3), or "Shoulder Ballast" per WSDOT 9-03.9(2). However, non-organic, on-site soils could be used as bearing pad fill if they are placed at a moisture content near optimum. All bearing pad soil should be compacted to at least 95 percent of the Modified Proctor maximum dry density (based on ASTM:D-1557).

Bearing Pad Dimensions: We anticipate that the bearing pads will need to range from about four to seven feet thick, depending on the required overexcavation depth. Because foundation stresses are transferred outward as well as downward into the bearing soils, all bearing pads composed of structural fill soil should extend horizontally outward from the edge of each footing a distance equal to the bearing pad thickness. Therefore, an overexcavation that extends 24 inches below the footing base should also extend 24 inches outward from the footing edges.

Subgrade Verification: All footing subgrades should consist of either firm, unyielding, medium dense, native soils or suitable structural fill materials placed over native soils. Footings should never be cast atop loose, soft, or frozen soil, slough, debris, existing uncontrolled fill, or surfaces covered by standing water. We recommend that the condition of all subgrades be verified by an AMEC representative before any fill and/or concrete is placed.

Bearing Capacities: Based on the bearing subgrade conditions described above, we recommend that all footings be designed for the following allowable soil bearing capacities. These values incorporate static and seismic safety factors of at least 2.0 and 1.5, respectively.

Design Parameter	Allowable Value
Static Bearing Capacity	2500 psf
Seismic Bearing Capacity	3300 psf

Footing Settlements: We estimate that total post-construction static settlements of properly designed and constructed footings bearing on properly prepared subgrades will not exceed ½ inch. Differential settlements could approach one-half of the actual total settlement between adjacent foundation elements. These settlements would be reduced if the actual design bearing pressures are lower than our recommended maximum pressures.

Footing and Stemwall Backfill: To provide erosion protection and lateral load resistance, we recommend that all footing excavations be backfilled on both sides of the footings and stemwalls after the concrete has cured. Either imported structural fill or non-organic on-site soils can be used for this purpose, contingent on a suitable moisture content at the time of placement. Regardless of soil type, all footing backfill soil should be compacted to a density of at least 90 percent (based on ASTM:D-1557).

Lateral Resistance: Footings and stemwalls that have been properly backfilled as described above will resist lateral movements by means of passive earth pressure and base friction. We recommend using the following design values, which incorporate static and seismic safety factors of at least 1.5 and 1.1, respectively. Base friction can be combined with the respective passive pressure to resist static and seismic loads.

Design Parameter	Allowable Value
Static Passive Pressure	300 pcf
Seismic Passive Pressure	400 pcf
Base Friction Coefficient	0.4

6.3 Mat Foundations

In our opinion, a mat foundation will provide adequate support for the proposed basins if the subgrades are properly prepared. We offer the following comments and recommendations for purposes of mat foundation design and construction.

Foundation Depths: For frost and erosion protection, the bottom edge of all mat foundations should penetrate to a depth of at least 18 inches below adjacent outside grade. However, greater depths would be needed for liquefaction mitigation, as discussed previously in Section 6.1.

Bearing Subgrades: In our opinion, the loose soils underlying the proposed basin footprints are not well-suited for supporting mat foundations, due to their moderately high compressibility and susceptibility to liquefaction. In order to provide adequate bearing conditions, we recommend that the mat foundation gain support from the medium dense sands and silty sands, which lie at depths on the order of three to seven feet below existing grades. While suitable bearing for static design may be achieved at shallower depths in some portions of the site, excavation to 3 to 7 feet is described in Section 6.1 to reduce the risk of liquefaction-induced settlement. Where the bearing horizon depth exceeds the minimum depth required for liquefaction mitigation, adequate support can be accomplished by overexcavating to this bearing horizon depth and replacing the overlying soils with bearing pads of suitable structural fill (refer to Section 6.7 for structural fill requirements).

Base Course: To provide a level surface for the mat, and to prevent the upward wicking of groundwater under the mat, we recommend that a base course be placed over the exposed subgrade. This base course should be at least 12 inches thick and should consist of clean crushed rock such as "Crushed Surfacing Base Course" per WSDOT Standard Specification 9-03.9(3).

Subgrade Verification: Each mat foundation should bear on firm, unyielding, medium dense, native soils or on compacted structural fill. If the mat is to be founded on compacted structural fill, overexcavation should extend to medium dense, native soils. Foundations should never be cast atop loose, soft, or frozen soil, slough, debris, existing uncontrolled fill, or surfaces covered by standing water. We recommend that the condition of all subgrades be verified by an AMEC representative before any fill or concrete is placed.

Bearing Capacities: A mat foundation that bears on properly prepared subgrade soils can be designed for the following allowable soil bearing capacities, which incorporate static and seismic safety factors of at least 2.0 and 1.5, respectively.

Design Parameter	Allowable Value
Static Bearing Capacity	4000 psf
Seismic Bearing Capacity	5300 psf

Foundation Backfill: To provide erosion protection and lateral load resistance, we recommend that the foundation excavation be backfilled around the exterior sides of the mat after the concrete has cured. Either imported structural fill or non-organic on-site soils can be used for this purpose, contingent on a suitable moisture content at the time of placement. All backfill soil should be compacted to a density of at least 90 percent (based on ASTM:D-1557).

Estimated Settlements: We estimate that the total settlement of a properly designed and constructed mat foundation bearing on a properly prepared subgrade will not exceed 1 inch. Differential settlements across the width of the mat foundation could approach one-half of the total settlement.

Vertical Deflections: Mat foundations can deflect downward when vertical loads are applied, due to elastic compression of the subgrade. In our opinion, a subgrade reaction modulus of 100 pounds per cubic inch can be used to estimate such deflections.

Lateral Resistance: Mat foundations can resist lateral loads by means of passive earth pressure acting on the sidewalls and by friction acting along the base. We recommend using the following design values, which incorporate static and seismic safety factors of at least 1.5 and 1.1, respectively. Base friction can be combined with the respective passive pressure to resist static and seismic loads.

Design Parameter	Allowable Value
Static Passive Pressure	300 pcf
Seismic Passive Pressure	400 pcf
Base Friction Coefficient	0.4

Uplift Pressure: Due to the shallow depth of the groundwater table, the basins should be designed to resist potential uplift forces. It is possible that the groundwater level could rise to ground surface elevation. Therefore, design uplift pressures can be determined by multiplying 62.4 pcf (pounds per cubic foot), the unit weight of water, by the depth of the basins below the ground surface. The uplift pressures should be applied to the base area of the proposed basins. For the basins, it may be feasible to include one-way pressure relief valves in the floor, for the condition of high groundwater and empty tank.

6.4 Slab-on-Grade Floors

In our opinion, soil-supported slab-on-grade floors can be used in the proposed buildings if the subgrades are properly prepared and mitigated for liquefaction. Alternatively, a structurally supported (post-tensioned) slab-on-grade floor can be used, without the need for rigorous subgrade preparation. We offer the following comments and recommendations concerning these two types of slab-on-grade floors.

Subgrade Conditions and Verification: All soil-supported slab-on-grade floors should bear on firm, unyielding, medium dense, native soils or on suitable structural fill soils. Due to probable liquefaction-induced settlement in the event of a severe earthquake, AMEC recommends that the same subgrade and overexcavation recommendations made in Section 6.1 be followed. We recommend that the condition of all subgrades and overlying layers be verified by an AMEC representative before any fill or concrete is placed.

Floor Subbase: Structural fill subbases do not appear to be needed under soil-supported slab-on-grade floors at the site. However, the final decision regarding the need for subbases should be based on actual subgrade conditions observed at the time of construction.

Capillary Break: To retard the upward wicking of groundwater beneath the floor slab, we recommend that a capillary break be placed over the subgrade. Ideally, this capillary break would consist of a 4-inch-thick layer of pea gravel or other clean, uniform, well-rounded gravel, such as "Gravel Backfill for Drains" per WSDOT: 9-03.12(4). Alternatively, angular gravel or crushed rock can be used if it is sufficiently clean and uniform to prevent capillary wicking.

Vapor Barrier: We recommend that a layer of durable plastic sheeting (such as Crosstuff, Moistop, or Visqueen) be placed directly between the capillary break and the floor slab to prevent ground moisture vapors from migrating upward through the slab. However, vapor barriers can be considered optional for use under floors that will not be covered with moisture-sensitive materials. If a vapor barrier is used, the contractor should exercise care to avoid puncturing it while casting the slab.

Curing Course: A "curing course" is a thin layer (typically 2 inches thick) of clean sand that is sometimes placed over the vapor barrier to facilitate uniform curing of the overlying concrete slab. Recent studies, however, have indicated that this course is not necessary when moderately strong concrete is used for the slab, and some structural engineers believe it can be detrimental to a slab's long-term performance. Consequently, we recommend that the project structural engineer be allowed to decide whether a curing course should be used.

Vertical Deflections: Soil-supported slab-on-grade floors can deflect downward when vertical loads are applied, due to elastic compression of the subgrade. In our opinion, a subgrade reaction modulus of 100 pounds per cubic inch can be used to estimate such deflections. For structurally supported slab-on-grade floors, this subgrade reaction modulus should be neglected, due to the potential for the subgrade to gradually settle away from the floor.

6.5 Drainage Systems

In our opinion, the buildings should be provided with permanent drainage systems to minimize the risk of future moisture problems. We offer the following recommendations and comments for drainage design and construction purposes.

Perimeter Drains: We recommend that each building be encircled with a perimeter drain system to collect seepage water. This drain should consist of a 4-inch-diameter perforated pipe within an envelope of pea gravel or washed rock, extending at least 6 inches on all sides of the pipe, and the gravel envelope should be wrapped with filter fabric to reduce the migration of fines from the surrounding soils. Ideally, the drain invert would be installed no more than 8 inches above or below the base of the perimeter footings or mat foundation.

Subfloor Drains: Based on the groundwater conditions observed in our site explorations, we do not infer a need for subfloor drains. However, the final decision regarding the need for subfloor drains should be made at the time of construction, after the floor subgrade has been exposed.

Runoff Water: Roof-runoff and surface-runoff water should *not* be allowed to flow into the drainage systems. Instead, these sources should flow into separate tightline pipes and be routed away from the buildings to an appropriate location. Also, final site grades should slope downward away from each building so that runoff water will flow by gravity to suitable collection points, rather than ponding near the buildings. Ideally, the area surrounding the buildings would be capped with concrete, asphalt, or low-permeability (silty) soils to minimize or preclude surface-water infiltration.

Discharge Considerations: If possible, all perimeter drains should discharge to the site storm drain system, or other suitable location by gravity flow. However, the depth of the excavation relative to existing utilities might not allow for gravity flow. In this event, we recommend that an on-demand pump be provided to collect groundwater and discharge it to a suitable location. In this case, check valves should be installed along any drainpipes, to prevent backflow into the drain system.

6.6 Backfilled Walls

The proposed walls of the basins will be partially below grade and should be treated as a backfilled wall. Our backfilled wall design recommendations and comments are presented below.

Backfill Soil: Ideally, all retaining wall backfill placed behind the curtain drain should consist of clean, free-draining, granular material, such as "Gravel Backfill for Walls" per WSDOT Standard Specification 9-03.12(2). Alternatively, on-site granular soils could be used as backfill if they are placed at a moisture content near optimum.

Backfill Compaction: Because soil compactors place significant lateral pressures on retaining walls, we recommend that only small, hand-operated compaction equipment be used within 3 feet of a backfilled wall. Also, all backfill should be compacted to a density as close as possible to 90 percent of the maximum dry density (based on ASTM:D-1557); a greater degree of compaction

closely behind the wall would increase the lateral earth pressure, whereas a lesser degree of compaction might lead to excessive post-construction settlements.

Grading and Capping: To retard the infiltration of surface water into the backfill soils, we recommend that the backfill surface of exterior walls be adequately sloped to drain away from the wall. Ideally, the backfill surface directly behind a wall would be capped with asphalt, concrete, or 12 inches of low-permeability (silty) soils to minimize or preclude surface water infiltration.

Applied Loads: Overturning and sliding loads applied to retaining walls can be classified as static pressures, surcharge pressures, seismic pressures, and hydrostatic pressures. We offer the following specific values for design purposes.

Static Pressures: Yielding (cantilever) retaining walls should be designed to withstand an appropriate *active* lateral earth pressure, whereas non-yielding (restrained) walls should be designed to withstand an appropriate *at-rest* lateral earth pressure. These pressures act over the entire back of the wall and vary with the backslope inclination. Assuming a level backslope, we recommend using active and at-rest pressures of 35 pcf and 55 pcf, respectively.

- *Surcharge Pressures*: Static lateral earth pressures acting on a retaining wall should be increased to account for surcharge loadings resulting from any traffic, construction equipment, material stockpiles, or structures located within a horizontal distance equal to the wall height. The enclosed *Surcharge Pressure Diagrams* (Figure 3) illustrate methods of calculating surcharge loads. For simplicity, a traffic surcharge can be modeled as a uniform pressure of 75 psf acting against the upper 6 feet of wall.

- *Seismic Pressures*: Static lateral earth pressures acting on a retaining wall should be increased to account for seismic loadings. These pressures act over the entire back of the wall and vary with the backslope inclination, the seismic acceleration, and the wall height. Based on a design acceleration coefficient of 0.27g and a wall height of "H" feet, we recommend that these seismic loadings be modeled as uniform active and at-rest pressures of 4H psf and 12H psf, respectively, assuming a level backslope.

- *Hydrostatic Pressures*: The water table is shallow within the project area and can be expected to rise and saturate the subgrade and backfill soils. Therefore, subgrade walls should be designed to withstand a hydrostatic pressure of 62.4 pcf.

6.7 Structural Fill

The term "structural fill" refers to any materials used for building pads, roadway embankments, and detention pond berms, as well as materials placed under foundations, retaining walls, slab-on-grade floors, sidewalks, pavements, and other such features. Our comments, conclusions, and recommendations concerning structural fill are presented in the following paragraphs.

Materials: Typical structural fill materials include clean sand, granulithic gravel, pea gravel, washed rock, crushed rock, quarry spalls, controlled-density fill (CDF), lean-mix concrete (LMC), well-graded mixtures of sand and gravel (commonly called "gravel borrow" or "pit-run"), and miscellaneous mixtures of silt, sand, and gravel. Recycled asphalt, concrete, and glass, which are derived from pulverizing the parent materials, are also potentially useful as structural fill in certain applications. Soils used for structural fill should not contain any organic matter or debris, nor any individual particles greater than about 6 inches in diameter.

Fill Placement: Generally, pea gravel, washed rock, quarry spalls, CDF, and LMC do not require special placement and compaction procedures. In contrast, clean sand, granulithic gravel, crushed rock, soil mixtures, and recycled materials should be placed in horizontal lifts not exceeding 8 inches in loose thickness, and each lift should be thoroughly compacted with a mechanical compactor.

Compaction Criteria: Using the Modified Proctor test (ASTM:D-1557) as a standard, we recommend that structural fill used for various on-site applications be compacted to the following minimum densities:

Fill Application	Minimum Compaction
Building pad	90 percent
Footing and mat subgrade or bearing pad	95 percent
Footing and wall backfill	90 percent
Slab-on-grade floor subgrade and subbase	90 percent
Asphaltic pavement subgrade (upper 2 feet)	95 percent
Asphaltic pavement subgrade (below 2 feet)	90 percent

Subgrade Verification and Compaction Testing: Regardless of material or location, all structural fill should be placed over firm, unyielding subgrades prepared in accordance with the *Site Preparation* section of this report. The condition of all subgrades should be verified by an AMEC representative before filling or construction begins. Also, fill soil compaction should be verified by means of in-place density tests performed during fill placement so that adequacy of soil compaction efforts may be evaluated as earthwork progresses.

Soil Moisture Considerations: The suitability of soils used for structural fill depends primarily on their grain-size distribution and moisture content when they are placed. As the "fines" content (that soil fraction passing the U.S. No. 200 Sieve) increases, soils become more sensitive to small changes in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 2 percentage points above or below optimum. For fill placement during wet-weather site work, we recommend using "clean" fill, which refers to soils that have a fines content of 5 percent or less (by weight) based on the soil fraction passing the U.S. No. 4 Sieve.

A material such as "Gravel Backfill for Drains," per WSDOT 9-03.12(4) would be suitable for this application, although other soils (including on-site clean sands) would also be suitable for wet-weather grading.

6.8 Underground Utilities

We understand that underground utilities, such as waterlines, storm drains, sewer pipes, manholes, and utilidors, will be included in the site development. Our comments and recommendations concerning the installation of these utilities are presented below.

Soil Classifications: Based on our explorations, we interpret the on-site soils to conform with the following OSHA soil classifications. However, these interpreted soil types should be confirmed after the initial excavations have begun. In all cases, the utility excavations should be performed in accordance with appropriate governmental guidelines.

On-Site Soil Type	OSHA Soil Type
Loose to Medium-Dense SAND	C
Medium-Dense to Dense Silty SAND	B
Saturated or wet soils	C

Subgrade Soils: Based on our explorations, we expect that most or all utility excavations will extend into soils that will adequately support utility pipes, utilidors, vaults, and similar structures. If localized zones of soft or organic soils are encountered in utility excavations, we generally recommend that they be overexcavated to a maximum depth of 24 inches and be replaced with a suitable fill material compacted to a uniform density of at least 90 percent (based on ASTM:D-1557).

Total dynamic settlements, due to liquefaction on the order of 2 inches was anticipated in the event of the 475-year earthquake. Differential settlements can be estimated as 2 inches over 50 feet. If utilities are not flexible enough to handle these settlements, the liquefaction settlements can be mitigated by overexcavation of the utility trench to medium dense soils and replacement with compacted structural fill.

Soil Corrosivity: Our scope of work did not include corrosivity testing of the on-site soils. However, based on our classifications of these soils and on our previous corrosivity testing of similar soil types, we do not infer that the on-site soils have a high likelihood of being corrosive to utilities.

Bedding Soils: Utility pipes should be bedded with an appropriate material that extends at least 6 inches outward from the pipe in all directions. For level or gently sloping pipes, we recommend using a clean, uniform, well-rounded material such as pea gravel or "Gravel Backfill for Pipe Bedding" per WSDOT: 9-03.12(3). For moderately or steeply sloping pipes, on the other hand, we recommend using a clean, uniform, angular material such as "Crushed Surfacing Top course" per WSDOT: 9-03.9(3), in order to minimize groundwater flow rates through the bedding.

Backfill Soils: The on-site, non-organic, granular soils can be used as utility excavation backfill if they are placed at a moisture content near optimum. During the wet season or during rainy periods, however, all backfill material used for utility trenches and other excavations would probably need to consist of well-graded granular soils such as "Gravel Borrow" per WSDOT: 9-03.14. Controlled-density fill (CDF) could be used as a more convenient, but also more expensive, alternative to backfill soil in any weather conditions.

Backfill Compaction: We generally recommend that utility backfill soils be compacted to a density commensurate with surrounding fill or native soils, as well as with the requirements of any overlying structures. For backfill placed under future concrete floors or drive slabs, all soil should be compacted to a uniform density of at least 90 percent (based on ASTM:D-1557). For backfill placed under future asphaltic pavements, the upper 2 feet should be compacted to at least 95 percent. CDF backfill does not require compaction but should have a compressive strength commensurate with the application.

6.9 Asphaltic Pavements

We understand that asphaltic pavements will be used for the new car-parking areas and access driveways. The following comments and recommendations are given for pavement design and construction purposes.

Subgrade Preparation: All soil subgrades should be proof-rolled with a loaded dump truck or heavy compactor to verify the density. Any areas where silts or loose sands are present at or closely beneath the pavement subgrade, as well as any localized zones of yielding subgrade disclosed during this proof-rolling operation, should be overexcavated to a maximum depth of 24 inches and replaced with a suitable structural fill material. All structural fill should be compacted according to our recommendations given in the *Structural Fill* section. Specifically, the upper 2 feet of soils underlying pavement section should be compacted to at least 95 percent, and all soils below 2 feet should be compacted to at least 90 percent (based on ASTM:D-1557).

Soil Design Values: Soil conditions can be defined by a California Bearing Ratio (CBR), which quantitatively predicts the effects of wheel loads imposed on a saturated subgrade. Based on our classifications of on-site soils and our previous laboratory testing performed on similar soils, we estimate that the near-surface soils will provide a CBR value of about 15 percent.

Traffic Design Values: Traffic conditions can be defined by a Traffic Index (TI), which quantifies the combined effects of projected car, truck, and bus traffic. Although no specific traffic data was available at the time of our analysis, we estimate that a TI of 3.0 is appropriate for low-volume car traffic areas and small parking lots.

Conventional Sections: A conventional pavement section typically comprises an asphalt concrete pavement over a crushed rock base course over a granular subbase course. Based on the estimated design values stated above, we recommend using the following minimum conventional pavement sections:

Pavement Course	Minimum Thickness Car Areas and Driveways
Asphalt Concrete Pavement	2 ½ inches
Crushed Rock Base	4 inches
Granular Subbase	0 inches

Pavement Materials: For the base course, we recommend using imported clean, crushed rock, such as "Crushed Surfacing Top Course" per WSDOT: 9-03.9(3).

Compaction and Verification: All base course material should be compacted to at least 95 percent of the Modified Proctor maximum dry density (ASTM:D-1557), and all asphalt concrete should be compacted to at least 92 percent of the Rice value (ASTM:D-2041). We recommend that an AMEC representative be retained to verify the compaction of each course before any overlying layer is placed. For the pavement course, compaction is best verified by means of frequent density testing; for the base course, methodology observations and hand probing are more appropriate than density testing.

Pavement Life and Maintenance: It should be realized that no asphaltic pavement is maintenance-free. The above described pavement sections represent our minimum recommendations for an average level of performance during a 20-year design life; therefore, an average level of maintenance will likely be required. Furthermore, a 20-year pavement life typically assumes that an overlay will be placed after about 10 years. Thicker asphalt, base, and subbase courses would offer better long-term performance, but would cost more initially; thinner courses would be more susceptible to "alligator" cracking and other failure modes. As such, pavement design can be considered a compromise between a high initial cost and low maintenance costs versus a low initial cost and higher maintenance costs.

7.0 RECOMMENDED ADDITIONAL SERVICES

Because the future performance and integrity of the structural elements will depend largely on proper site preparation, drainage, fill placement, and construction procedures, monitoring and testing by experienced geotechnical personnel should be considered an integral part of the construction process. Consequently, we recommend that AMEC be retained to provide the following post-report services:

- Discuss important geotechnically related construction issues with the design team and contractor at a coordination meeting;
- Confirm that suitable subgrade conditions have been reached;
- Monitor the placement of all structural fill and test the compaction of structural fill soils to verify their conformance with the construction specifications;
- Check all completed subgrades for footings and slab-on-grade floors before concrete is poured, in order to verify their bearing capacity; and
- Prepare a post-construction letter summarizing all field observations, inspections, and test results.

8.0 CLOSURE

The conclusions and recommendations presented in this report are based, in part, on the explorations that we performed and utilized for this study; therefore, if variations in the subgrade conditions are observed at a later time, we may need to modify this report to reflect those changes. Also, because the future performance and integrity of the project elements depend largely on proper initial site preparation, drainage, and construction procedures, monitoring and testing by experienced geotechnical personnel should be considered an integral part of the construction process. AMEC is available to provide geotechnical monitoring, soils and concrete testing, steel and masonry inspection, and other services throughout construction.

We appreciate the opportunity to be of service on this project. If you have any questions regarding this report or any aspects of the project, please feel free to contact our office.

Sincerely,

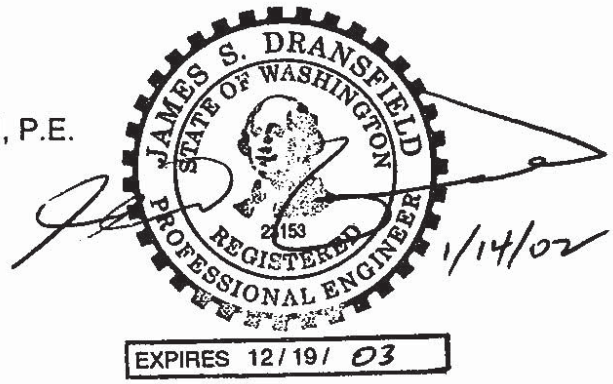
AMEC Earth & Environmental, Inc.

Tamara M. Miller

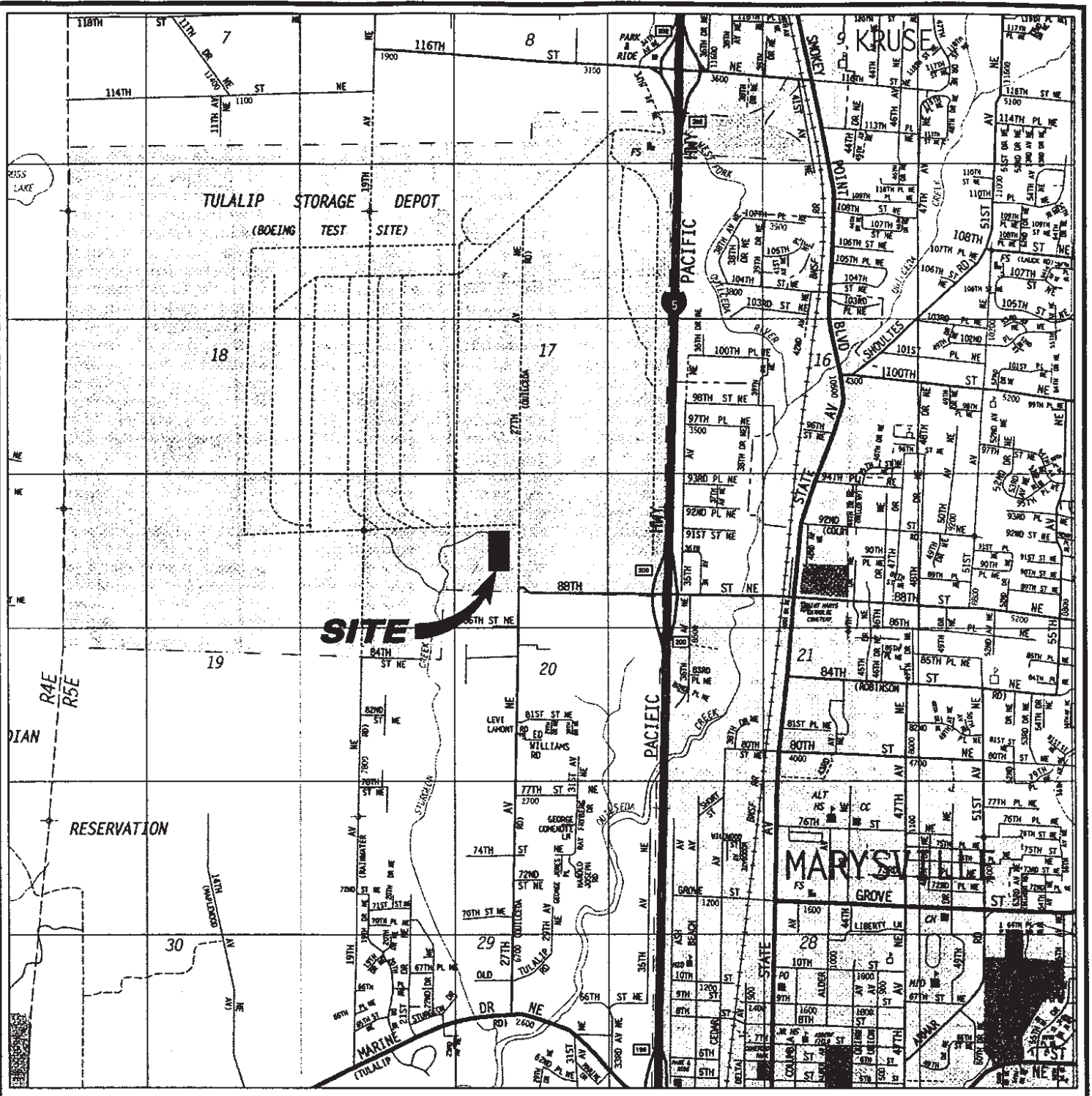
Tamara M. Miller
Senior Staff Engineer

James S. Dransfield, P.E.
Principal

TMM/JSD/kms



FIGURES



N.T.S.

JOB NO.: 1-91M-13845-A | DWG DATE: 12-15-2001 | SCALE: N.T.S. | DESIGN BY: TMM | FILE NAME: LOCATION.DWG

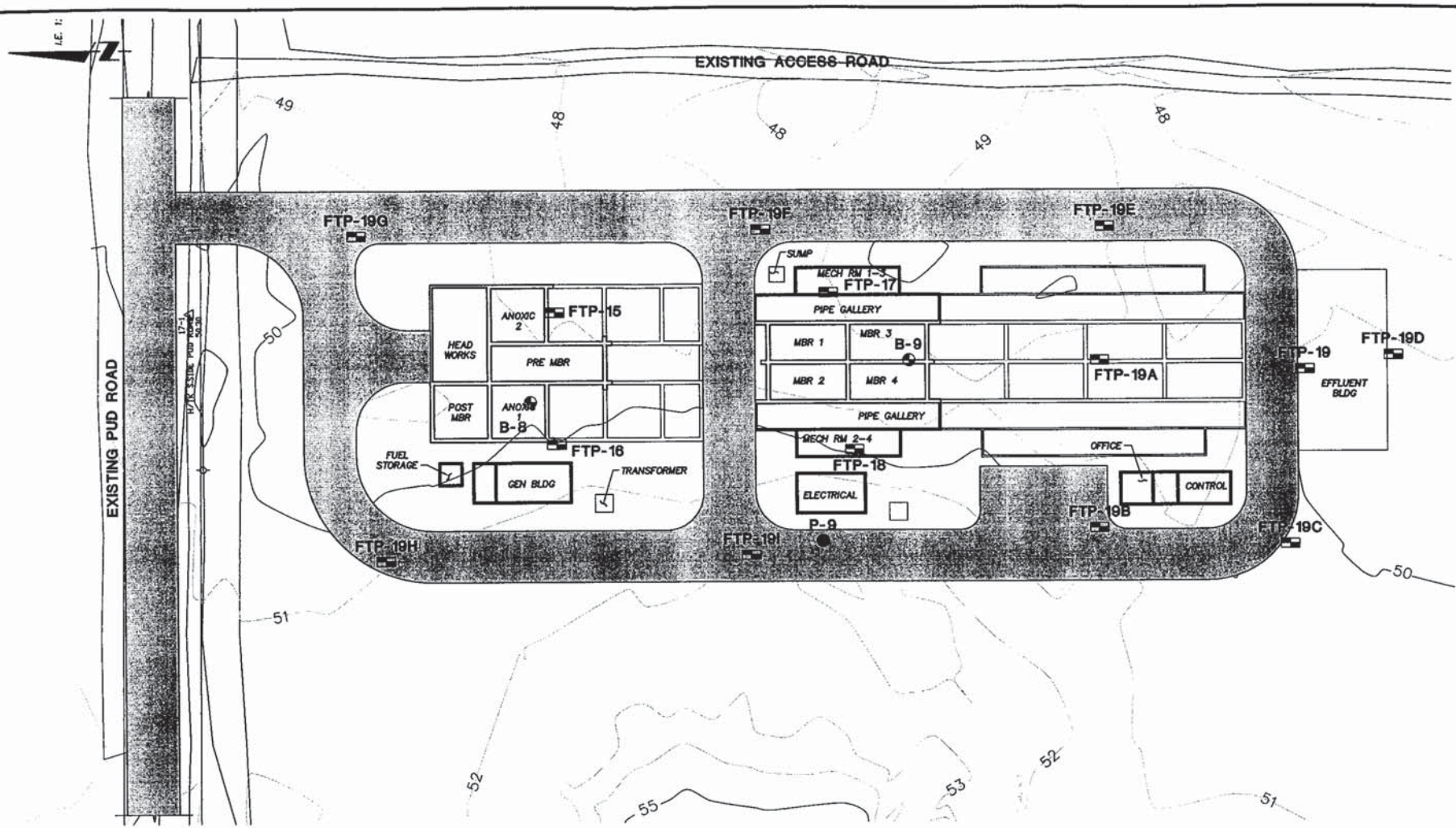
AMEC EARTH AND ENVIRONMENTAL, INC.
11335 N.E. 122nd Way, Suite 100
Kirkland, WA, U.S.A. 98034-6918

LOCATION MAP

WASTEWATER TREATMENT PLANT

TULALIP, WASHINGTON

FIGURE 1



LEGEND

FTP-19I TEST PIT NUMBER AND APPROXIMATE LOCATION

B-9 BORING NUMBER AND APPROXIMATE LOCATION

P-9 PIEZOMETER NUMBER AND APPROXIMATE LOCATION

0 40 80
SCALE IN FEET

amec
AMEC EARTH AND ENVIRONMENTAL, INC.
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Kirkland, WA, U.S.A. 98034-6918

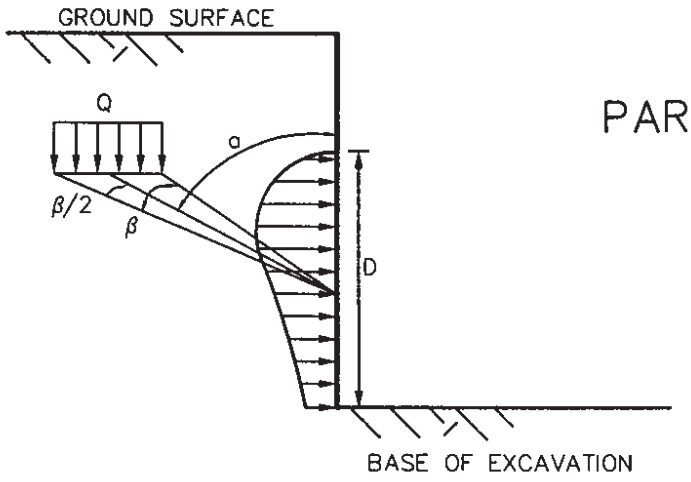
SITE AND EXPLORATION PLAN

WASTEWATER TREATMENT PLANT

TULALIP, WASHINGTON

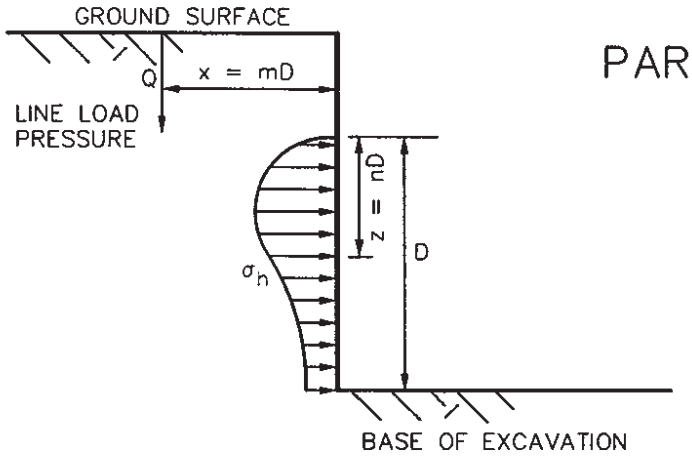
FIGURE 2

JOB NO.: 1-91M-13845-A | DWG DATE: 12-17-2001 | SCALE: 1"=40' | DESIGN BY: TMM | FILE NAME: FIGURE-R.DWG



STRIP FOOTING PARALLEL TO EXCAVATION

$$\sigma_h = 0.64Q(\beta - \sin\beta\cos 2\alpha)$$



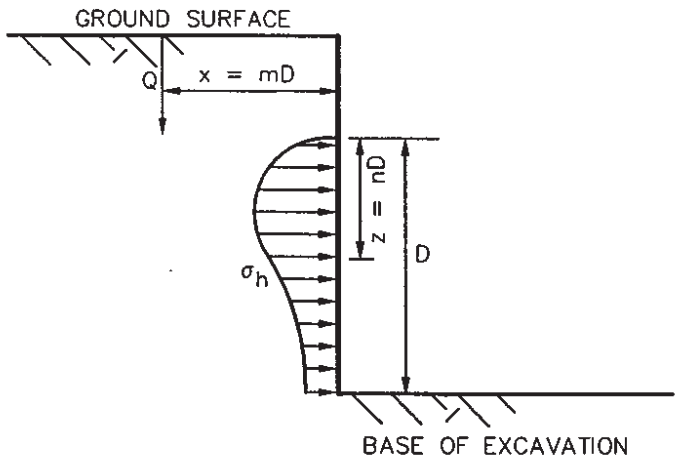
LINE LOAD PARALLEL TO EXCAVATION

(FOR $m > 0.4$)

$$\sigma_h = \frac{1.28Q}{D} \cdot \frac{m^2 n}{(m^2 + n^2)^2}$$

(FOR $m \leq 0.4$)

$$\sigma_h = \frac{Q}{D} \cdot \frac{0.2\ n}{(0.16 + n^2)^2}$$



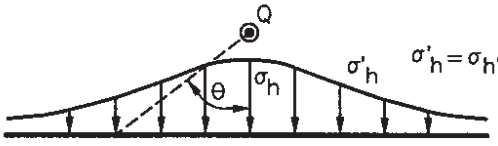
POINT LOAD

(FOR $m > 0.4$)

$$\sigma_h = \frac{1.77Q}{D^2} \cdot \frac{m^2 n^2}{(m^2 + n^2)^3}$$

(FOR $m \leq 0.4$)

$$\sigma_h = \frac{0.28Q}{D^2} \cdot \frac{n^2}{(0.16 + n^2)^3}$$



PLAN VIEW OF WALL

amec
AMEC EARTH AND ENVIRONMENTAL, INC.
11335 N.E. 122nd Way, Suite 100
Kirkland, WA, U.S.A. 98034-6918

SITE AND EXPLORATION PLAN

WASTEWATER TREATMENT PLANT

TULALIP, WASHINGTON

FIGURE 3

JOB NO.: 1-91M-133845-A | DWG DATE: 12-15-2001 | SCALE: N.T.S. | DESIGN BY: TMM | FILE NAME: PRESSURE-DIAGRAM.DWG

APPENDIX A

FIELD EXPLORATION PROCEDURES AND LOGS

APPENDIX A
FIELD EXPLORATION PROCEDURES AND LOGS
1-91M-13845-A

The following paragraphs describe our procedures associated with the field explorations and field tests that we conducted for this project. Descriptive logs of our explorations are enclosed in this appendix.

Auger Boring Procedures

Our exploratory borings were advanced with a hollow-stem auger, using a truck-mounted drill rig operated by an independent drilling firm working under subcontract to AMEC. A geotechnical specialist from our firm continuously observed the borings, logged the subsurface conditions, and collected representative soil samples. All samples were stored in watertight containers and later transported to our laboratory for further visual examination and testing. After each boring was completed, the borehole was backfilled with a mixture of bentonite chips and soil cuttings, and the surface was patched with asphalt or concrete (where appropriate).

Throughout the drilling operation, soil samples were obtained at 2½- or 5-foot depth intervals by means of the Standard Penetration Test (SPT) per ASTM:D-1586. This testing and sampling procedure consists of driving a standard 2-inch-diameter steel split-spoon sampler 18 inches into the soil with a 140-pound hammer free-falling 30 inches. The number of blows required to drive the sampler through each 6-inch interval is counted, and the total number of blows struck during the final 12 inches is recorded as the Standard Penetration Resistance, or "SPT blow count." If a total of 50 blows are struck within any 6-inch interval, the driving is stopped and the blow count is recorded as 50 blows for the actual penetration distance. The resulting Standard Penetration Resistance values indicate the relative density of granular soils and the relative consistency of cohesive soils.

The enclosed *Boring Logs* describe the vertical sequence of soils and materials encountered in each boring, based primarily on our field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradational, our logs indicate the average contact depth. Where a soil type changed between sample intervals, we inferred the contact depth. Our logs also graphically indicate the blow count, sample type, sample number, and approximate depth of each soil sample obtained from the borings, as well as any laboratory tests performed on these soil samples. If any groundwater was encountered in a borehole, the approximate groundwater depth is depicted on the boring log. Groundwater depth estimates are typically based on the moisture content of soil samples, the wetted height on the drilling rods, and the water level measured in the borehole after the auger has been extracted.

Well Installation Procedures

Our groundwater observation wells consist of 2-inch-diameter PVC pipe, the lower 10 feet of which is finely slotted. The annular space around the slotted segment was backfilled with clean sand, and the upper portion of annulus was sealed with bentonite chips and concrete. A flush-mounted monument was placed over the top of each wellhead for protection. The as-built configuration of each observation well is illustrated on the respective *Boring Log*. Our logs also show any post-drilling groundwater levels measured in the wells, along with the date of measurement.

Test Pit Procedures

Our exploratory test pits were excavated with a rubber-tired backhoe operated by an employee of the Tulalip Tribe. A geotechnical specialist from our firm continuously observed the test pit excavations, logged the subsurface conditions, and obtained representative soil samples. All samples were stored in watertight containers and later transported to our laboratory for further visual examination and testing. After we logged each test pit, the hoe operator backfilled it with excavated soils and tamped the surface.

The enclosed *Test Pit Logs* indicate the vertical sequence of soils and materials encountered in each test pit, based primarily on our field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradational or undulating, our logs indicate the average contact depth. We estimated the relative density and consistency of the in-situ soils by means of the excavation characteristics and the stability of the test pit sidewalls. Our logs also indicate the approximate depths of any sidewall caving or groundwater seepage observed in the test pits, as well as all sample numbers and sampling locations.

PROJECT: *Tulalip Wastewater Treatment Plant* W.O. *1-91M-13845-A* BORING No. *B-8*

Location: Treatment Plant: Anoxic Basin #1
Approximate ground surface elevation:

DEPTH (feet)	Soil Description	USCS/USGS GRAPHICS	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER
0	Loose, wet, dark brown, organic-rich silty SAND (Topsoil and Duff)				
	Loose, wet, rust-mottled tan, silty fine SAND				
	Medium dense, wet, reddish tan/brown, fine to medium SAND with some silt			S1	
5	Medium dense, saturated, gray, fine SAND with some silt			S2	ATD
	Medium dense, saturated, gray, fine to medium SAND with trace to some course sand and trace silt			S3	
10					
	Medium dense to dense, saturated, gray, fine to medium SAND with some silt			S4	
15					
				S5	
20					
	grades fine SAND with some silt			S6	
25					
				S7	
30					

PENETRATION RESISTANCE
▲ Standard ⓗⓗ Blows over inches △ Other
Blows per foot
0 10 20 30 40 50

Page 1 of 2

TESTING

0 20 40 60 80 100
Plastic Limit — Moisture Content — Liquid Limit

LEGEND

2.00-inch OD split-spoon sampler

ATD Groundwater level at time of drilling

Grain Size Analysis

4IN1 B8-9.GPJ WA4IN1.GDT 12/19/01

amec

11335 N.E. 122nd Way Suite 100
Kirkland, Washington 98034-6913

Drilling Method: HSA Hammer type: Winch Date drilled: *December 07, 2001* Logged By: *WJL*

PROJECT: *Tulalip Wastewater Treatment Plant* W.O. *1-91M-13845-A* BORING No. *B-8*

Location: Treatment Plant: Anoxic Basin #1
Approximate ground surface elevation:

DEPTH (feet)	Soil Description	USCS/USGS GRAPHICS	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER
30	fine SAND with some silt as above			S8	
35	Dense, wet to saturated, gray, silty fine SAND with interbedded 1/4-inch thick stringers of fine sandy SILT			S9	
40	Boring terminated at approximately 39 feet below existing ground surface				
45					
50					
55					
60					

PENETRATION RESISTANCE
Standard ▲ Blows over inches ▨ Other △
Blows per foot
0 10 20 30 40 50

Page 2 of 2

TESTING

0 20 40 60 80 100
Plastic Limit — Moisture Content — Liquid Limit

LEGEND

- 2.00-inch OD split-spoon sampler
- ATD Groundwater level at time of drilling
- Grain Size Analysis

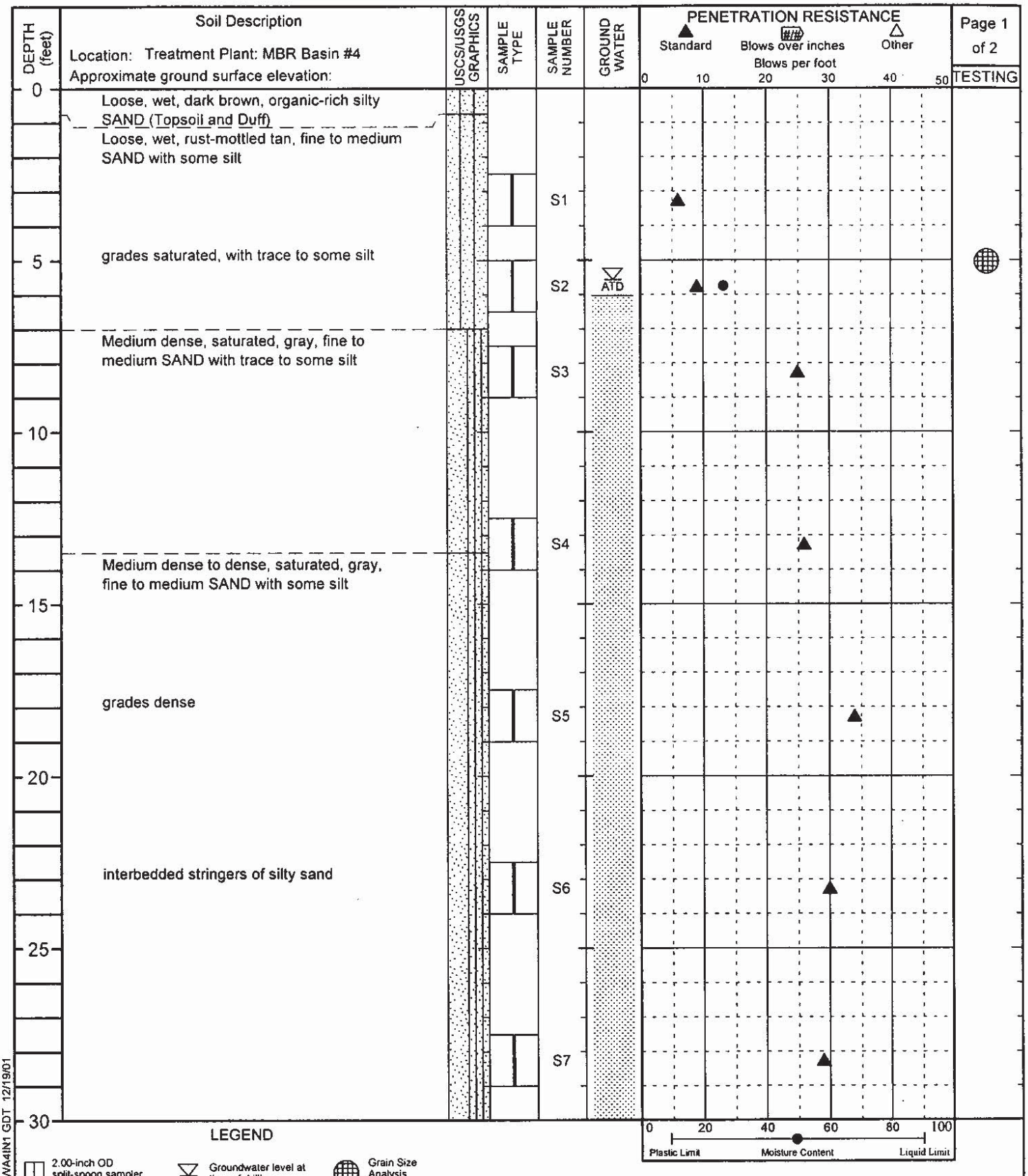
amec

11335 N.E. 122nd Way Suite 100
Kirkland, Washington 98034-6913

Drilling Method: HSA Hammer type: Winch Date drilled: *December 07, 2001* Logged By: *WJL*

4IN1 B8-9.GPJ WA4IN1.GDT 12/19/01

PROJECT: *Tulalip Wastewater Treatment Plant* W.O. *1-91M-13845-A* BORING No. *B-9*



LEGEND

2.00-inch OD split-spoon sampler

ATD Groundwater level at time of drilling

Grain Size Analysis

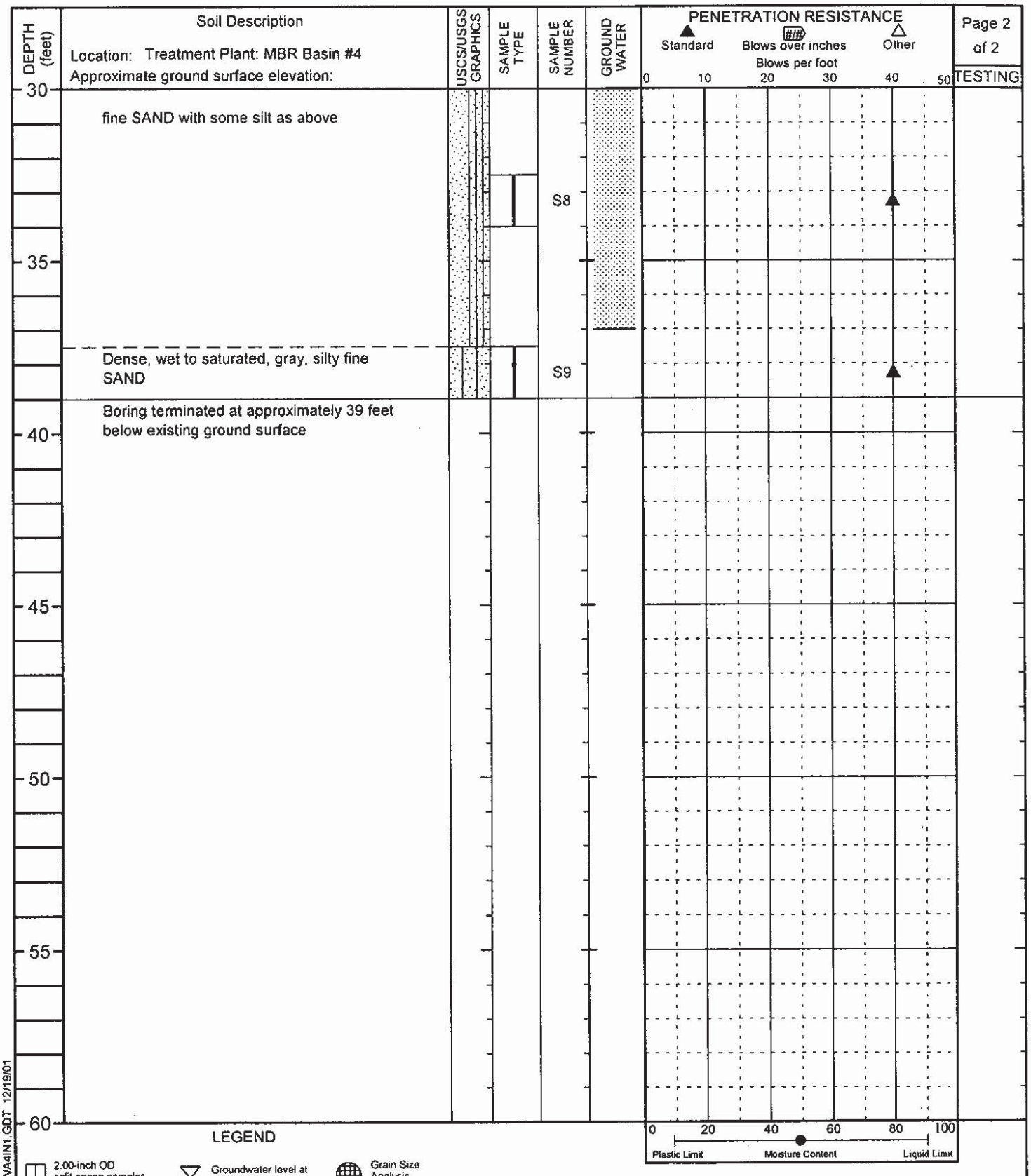
amec

11335 N.E. 122nd Way Suite 100
Kirkland, Washington 98034-6913

4IN1 B8-9.GPJ WA4IN1.GDT 12/19/01

Drilling Method: HSA Hammer type: Winch Date drilled: *December 07, 2001* Logged By: *WJL*

PROJECT: *Tulalip Wastewater Treatment Plant* W.O. *1-91M-13845-A* BORING No. *B-9*



LEGEND

2.00-inch OD split-spoon sampler

ATD Groundwater level at time of drilling

Grain Size Analysis

amec

11335 N.E. 122nd Way Suite 100
Kirkland, Washington 98034-6913

Drilling Method: HSA Hammer type: Winch Date drilled: *December 07, 2001* Logged By: *WJL*

4IN1 B8-9.GPJ WA4IN1.GDT 12/19/01

PROJECT: *Wastewater Treatment Plant* W.O. *1-91M-13845-A* BORING No. *P-9*

Elevation reference: Well completed: November 07, 2001

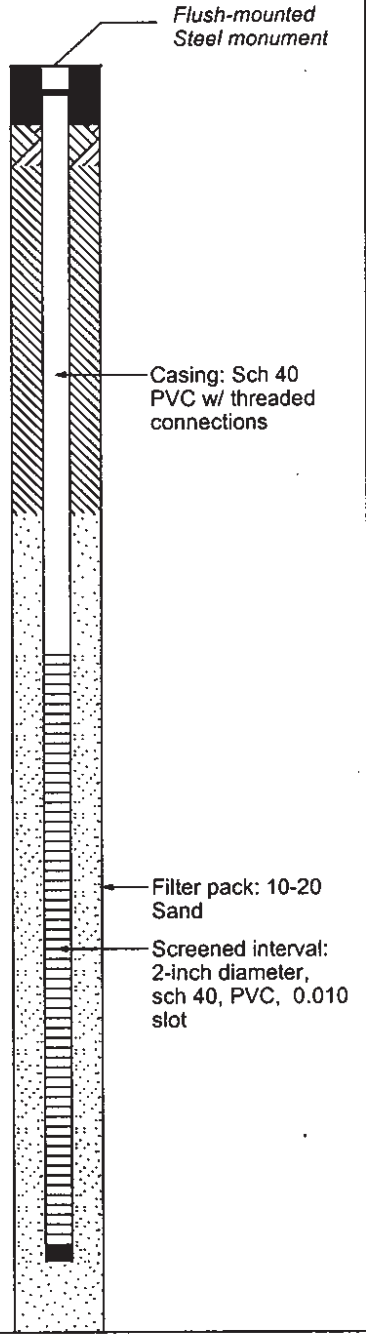
Ground surface elevation: Casing elevation:

AS-BUILT DESIGN

Page 1 of 1

DEPTH (feet)	SOIL DESCRIPTION	USCS/USGS GRAPHICS	SAMPLE TYPE	SAMPLE NUMBER	BLOW COUNTS	OVM READING	GROUND WATER
0	Field grass and weeds over: Wood debris within a dark brown/black silty SAND matrix (FILL)						
	Medium dense, moist to wet, reddish tan, fine to medium SAND with some silt			S-1	17		
5				S-2	20		
	grades wet, tan with some iron oxide staining, fine to medium SAND with trace to some silt						
	Medium dense, saturated, gray, fine to medium SAND with trace silt						ATD
10				S-3	21		
15				S-4	32		
	Dense, saturated, silty fine SAND						
20	grades silty fine to medium SAND with stringers of clean sand			S-5	55		
	Boring terminated at approximately 21.5 feet below existing ground surface						
25							

TESTING



Well No.

LEGEND

2.00-inch OD split-spoon sampler

Observation well:

amec
11335 N.E. 122nd Way Suite 100
Kirkland, Washington 98034-6913

Drilling started: *November 14, 2001* Drilling completed: *November 14, 2001* Logged By: *WJL*

4IN1 P1-P9.GPJ WA4IN1.GDT 12/20/01

APPENDIX B

LABORATORY TESTING PROCEDURES AND RESULTS

APPENDIX B
LABORATORY TESTING PROCEDURES AND RESULTS
1-91M-13845-A

The following paragraphs describe our procedures associated with the laboratory tests that we conducted for this project. Graphical results of certain laboratory tests are enclosed in this appendix.

Visual Classification Procedures

Visual soil classifications were conducted on all samples in the field and on selected samples in our laboratory. All soils were classified in general accordance with the United Soil Classification System, which includes color, relative moisture content, primary soil type (based on grain size), and any accessory soil types. The resulting soil classifications are presented on the exploration logs contained in Appendix A.

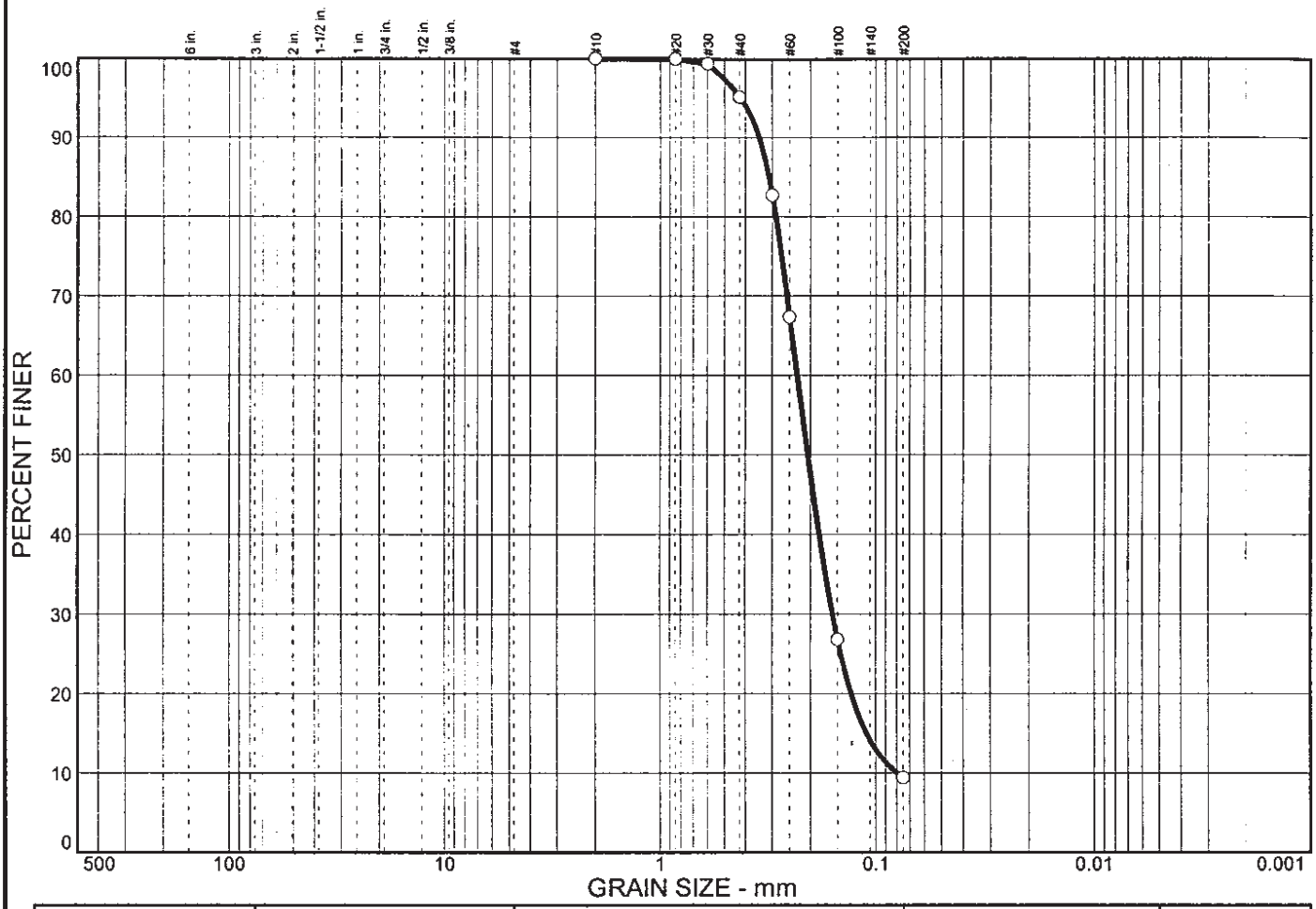
Moisture Content Determination Procedures

Moisture content determinations were performed on representative samples to aid in identification and correlation of soil types. All determinations were made in general accordance with ASTM:D-2216. The results of these tests are shown on the exploration logs contained in Appendix A.

Grain Size Analysis Procedures

A grain size analysis indicates the range of soil particle diameters included in a particular sample. Grain size analyses were performed on representative samples in general accordance with ASTM:D-422. The results of these tests are presented on the enclosed grain-size distribution graphs and were used in soil classifications shown on the exploration logs contained in Appendix A.

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	90.6	9.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	100.0		
#30	99.4		
#40	95.2		
#50	82.7		
#60	67.3		
#100	26.8		
#200	9.4		

* (no specification provided)

Soil Description

Dark gray sand some silt
Moisture=25.8%

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.311 D_{60}= 0.231 D_{50}= 0.206
D_{30}= 0.158 D_{15}= 0.110 D_{10}= 0.0797
C_u= 2.90 C_c= 1.36

Classification

USCS= AASHTO=

Remarks

Tested by: YY Reviewed by: ML
ASTM: C136, D1140, D2216
Sampled: 12/07/01

Sample No.: 4745.1 **Source of Sample:** **Date:** 12/14/01
Location: B-8, S-6 **Elev./Depth:** 22.5'

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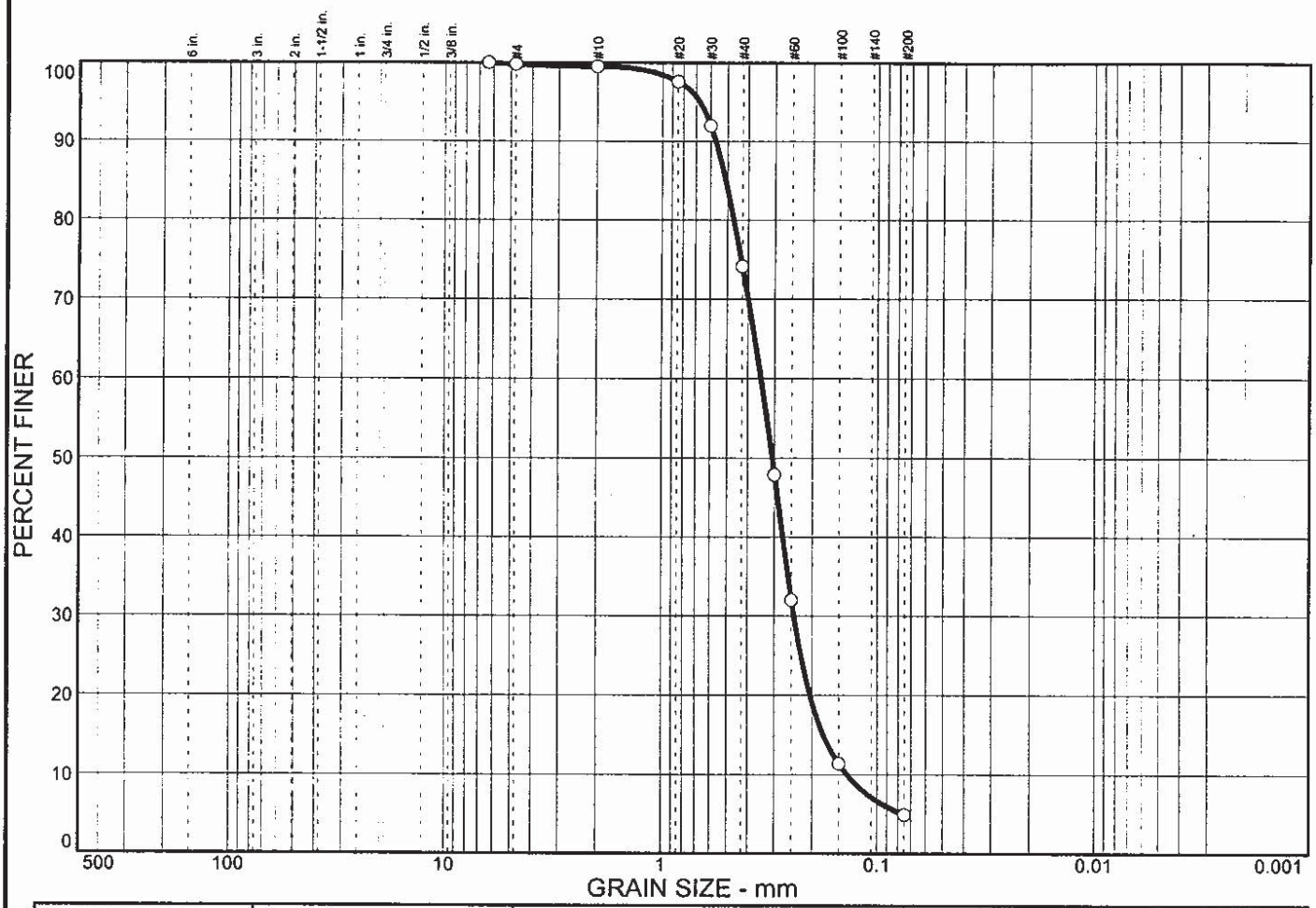
ENGINEERING GLOBAL SOLUTIONS

Client: Parametrix
Project: Tulalip Wastewater Plant
Project No: 1-91M-13845-A **Plate**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.2	94.9	4.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/4 in.	100.0		
#4	99.8		
#10	99.5		
#20	97.6		
#30	92.0		
#40	74.1		
#50	47.9		
#60	32.0		
#100	11.4		
#200	4.9		

* (no specification provided)

Soil Description

Gray sand trace silt
Moisture=26.4%

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.511 D_{60}= 0.348 D_{50}= 0.307
D_{30}= 0.243 D_{15}= 0.177 D_{10}= 0.137
C_u= 2.53 C_c= 1.24

Classification

USCS= AASHTO=

Remarks

Tested by: YY Reviewed by: ML
ASTM: C136, D1140, D2216
Sampled:12/07/01

Sample No.: 4745.2 **Source of Sample:** **Date:** 12/14.01
Location: B-9, S-2 **Elev./Depth:** 5'

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

Client: Parametrix
Project: Tulalip Wastewater Plant
Project No: 1-91M-13845-A **Plate**

Appendix C

Kubota Information

For Earth, For Life

Kubota

Firm Proposal for

Tulalip MBR System Upgrade

Membrane Bioreactor System

February 23, 2018

Prepared By:

Kubota Membrane USA
11807 North Creek Parkway S. Ste B-109
Bothell, WA 98011
425-898-2858

Local Representation By:

Goble Sampson Associates
Doug Allie
206-999-8436
dallie@goblesampson.com

February 23, 2018

For Earth, For Life
Kubota

Allan Maas, PE
Parametrix
1019 39th Avenue SE
Suite 100
Puyallup, WA 98374

Dear Mr. Maas:

I am pleased to present the attached updated materials and firm pricing for consideration regarding the proposed membrane bioreactor (MBR) system expansion of the Tulalip MBR System. Kubota Membrane USA is a company with a strong history in the U.S., backed by Kubota Corporation's extensive wastewater experience worldwide. Our Kubota MBR System brings unique features to save your client time and hassle. Most importantly, our product saves money over the life-cycle of the treatment system because of our high quality membrane.

A compelling feature of the Kubota MBR System is the simplicity of daily operations and periodical maintenance. Both the membrane unit itself and the MBR system are designed for the operator's convenience. Cleaning is performed in place, with no routine membrane unit removal required. Also, because the Kubota MBR System uses a flat sheet membrane, it offers straightforward troubleshooting and easy replacement in the unlikely event that problems arise.

Kubota Membrane USA offers first class service. Our technicians have operational experience and are well trained in wastewater analysis and membrane inspection. This sets us apart from other membrane manufacturers who do not design, build, or operate treatment plants, and system integrators who do not manufacture parts or operate plants. We are responsive to operator concerns and knowledgeable about the Kubota MBR System from top to bottom.

With the Kubota name comes a long history of excellence in MBR wastewater treatment. We are happy to put you in touch with operators and engineers who can share their experience with our product. If you have any questions regarding our proposal, please feel free to contact us or our local representative, Doug Allie of Goble Sampson Associates, at 206-999-8436 or dallie@goblesampson.com.

Best regards,

Kenna Foster
Application Engineer | Kubota Membrane USA Corporation
Office: 425-898-2858 ext. 108
Cell: 425-686-2705
Email: kenna.foster@kubota.com

Table of Contents

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2 Scope of Supply 1
2.1 Major Equipment and Instrumentation 1
2.2 Direct Services 3
2.3 Exclusions to Kubota Scope of Supply 3
3 Warranty 4
4 Firm Price 4
5 24/7 Technical Support 4
6 Additional Services (Optional) 4
Appendix A 6

Tables

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Table 2: Training and Workshops Included in Kubota’s Scope of Supply 3
Table 3: Budgetary Price for the Kubota MBR Equipment 4
Table 4: Kubota's Available Services 5

1 Introduction

In response to the information requested for the Tulalip MBR system upgrade project, we have updated our scope of supply and proposed pricing to reflect the following changes:

- Added 600 spare membrane cartridges.
- Removed 5-year extended full warranty.
- Changed piping material of the in-basin air outlet pipes from 304SS to CPVC.

2 Scope of Supply

The following proposed items will be supplied by Kubota Membrane USA (KMU), and are included in the firm price that is listed herein.

For additional clarity, we have provided a copy of the 90% P&IDs, provided by Parametrix on January 3, 2018, which we have highlighted to depict Kubota's scope of supply in Appendix A.

2.1 Major Equipment and Instrumentation

Table 1: Major Equipment and Instrumentation in Kubota's Scope of Supply

Name	Type	Manufacturer	Model	Size	Power Supply	Quantity
Submerged Membrane Unit (SMU)	Flat Plate	Kubota	EK400	-	-	16
Membrane Cartridges, Spare	Flat Plate	Kubota	Type 510	-	-	600
SMU Guide Pipes, Stabilizer Pipes, and Supports	-	Kubota	-	-	-	16 sets
Anchor Bolts	304SS, in-basin	Kubota	-	-	-	16 sets
Air Inlet Pipe and Supports	304SS, in-basin to flange before wall penetration	Kubota	-	3-inch and 2-inch	-	16 sets
Air Outlet Pipe and Supports	304SS, in-basin to flange before diffuser cleaning header	Kubota	-	3-inch and 2-inch	-	16 sets
Upper Permeate Pipe and Supports	PVC, in-basin to flange before wall penetration	Kubota	-	2.5-inch and 2-inch	-	16 sets
Lower Permeate Pipe and Supports	PVC, in-basin to flange before wall penetration	Kubota	-	2.5-inch and 2-inch	-	16 sets

Name	Type	Manufacturer	Model	Size	Power Supply	Quantity
Diffuser Cleaning Valve	Automated Butterfly Valve	EIM Actuator w/ Pratt Butterfly Valve	M2CP Electric Actuator for On/Off Service w/ AWWA Valve	10-inch	480V	2
Air Flow Meter	Thermal Mass Air Flow	FCI	ST98 with Remote Transmitter ST98 FlexMASSter	10-inch	120 VAC	2
Air Pressure Sensor	Sensor and Transmitter	Foxboro-Schneider	IGP10-T22D1F	-	24 VDC	2
Level Transducer	Ultrasonic, Class 1 Div 2	Siemens	XPS-15	-	-	3 (2 duty + 1 spare)
Controller	Controller for Level Transducer	Siemens	Hydroranger 200 HMI	-	100-230 VAC	1 (common controller for 2 transducers)
Level Switch	Float, Intrinsically Safe	Gems	Series M	-	24 VDC	4 (Low Level, one per basin)
Trans-Membrane Pressure (TMP) Transmitter	Diaphragm	Siemens	SITRANS P200	-	24 VDC	5 (4 duty + 1 spare)
Permeate Flow Control Valve	Automated Modulating Butterfly Valve, Fail Closed	EIM Actuator w/ Pratt Butterfly Valve	RTS Actuator for Modulating Service w/ AWWA Valve	6-inch	480V	4
Permeate Flow Control Valve Warranty	Extended Warranty for Actuator with > 2 actuations per minute	EIM	-	3 years	-	4
Permeate Flow Meter	Electromagnetic w/ Integral Transmitter	Siemens	FM MAG5100W	8-inch	120 VAC	2
Turbidity Meter	Optical Meter and Transmitter	ECD	Triton TR86	-	120 VAC	4
Check Valve	Siphon prevention on Turbidity Meter	TBD	TBD	½-inch	-	4
Clean-In-Place Isolation Valve	3-Way Manual Ball Valve	TBD	TBD	2-inch	-	32
Permeate Isolation Valve	Manual Ball Valve	Match existing	Match existing	2-inch	-	32
Sample Valve	Manual Ball Valve	TBD	TBD	1-inch	-	32
Air Isolation Valve	Manual Butterfly Valve	Match existing	Match existing	2-inch	-	16

2.2 Direct Services

The following services are all included in Kubota's scope of supply:

Design Support

- Design phase submittals
- Membrane tank drawings
- Drawing review
- MBR control narrative
- Construction phase submittals

Startup and Commissioning Support

- 1 day onsite for delivery inspection
- 6 days onsite for installation inspection and certification
- 14 days onsite for start-up and commissioning

Training

- 2 days onsite broken into two 3-hour sessions for operator training
- Please see Table 2 below for example of operator training topics.

Table 2: Training and Workshops Included in Kubota's Scope of Supply

Training/Workshop	Brief Summary
CIP training	1. Navigation of CIP (Clean-In-Place), in-situ maintenance chemical cleaning. 2. Control from HMI and operation of manual valve. 3. Adjust set points of chemical flow.
Troubleshooting	1. Case study of troubleshooting 2. Recovery from trouble 3. "Fish bone" approach
Daily testing	1. Filterability test 2. Viscosity measurement

Workshop/Additional Training Available (No Charge)

- In addition to our standard training at commissioning, Kubota Membrane USA will host an annual operator workshop in which operators meet to exchange ideas and learn about the latest developments in MBR technology.
- Customized individual training, such as membrane disassembling training, is also available upon request.

2.3 Exclusions to Kubota Scope of Supply

The following items are not included in the Kubota scope of supply:

- Process & Instrumentation Diagrams
- Equalization System (Pump, Mixer, Level Transmitters), if needed
- Pre-treatment (fine screen, grit removal, etc.)
- Equipment required for biological process
- Mixed Liquor Recycle pumps
- Permeate pumps

- Blowers
- Header piping (air, permeate)
- Control system, including SCADA, HMI, control panels, and all programming
- Motor controllers, VFDs
- Any modification to existing concrete tanks
- All out-of-basin permeate piping and wall penetrations
- All out-of-basin air piping and wall penetrations
- Diffuser cleaning header pipe
- Civil Works, installation and connection of tanks, piping, and wiring

3 Warranty

Equipment Warranty

Kubota's budgetary price listed in Section 4 includes Kubota's 2-year standard full membrane warranty, extended 3-year full warranty for actuators with an expected number of duty actuations exceeding two actuations per minute, and 1-year warranty for all other mechanical and electrical components included in Kubota's scope, is included in the price proposed and goes into effect at the commencement date of commissioning. The warranty included is a guarantee that the products supplied by Kubota are free from defect in material or workmanship.

4 Firm Price

The proposed firm price for the equipment and services described herein, including estimated freight to the site, is shown below *(Table 3)*:

Table 3: Budgetary Price for the Kubota MBR Equipment

Firm Price: Equipment and Services	
MBR Expansion (excluding any applicable taxes)	$981,700 ($0.9817M)

5 24/7 Technical Support

24/7 phone support is available in addition to support during regular business hours. 24-hour technical support calls are shared within the Kubota staff so that you can rest assured knowing that knowledgeable engineers and technicians are just a phone call away.

6 Additional Services (Optional)

The following service plans are optional and may be added to Kubota's scope of supply if desired for an additional cost.

Kubota Membrane Protection Plan

Under this plan, Kubota Membrane USA warrants against any membrane failure for 10 years when the system is operated in accordance with the O&M manual. This plan includes annual onsite membrane inspection with membrane examination and inspection report, periodic replacement of parts and damaged membranes (if any), and phone support during the 10 year period. With this plan, Kubota will replace each cartridge at least once during the 10-year span, regardless of necessity.

Kubota Custom Membrane Support Plan

Kubota can customize your support and service package to meet your needs.

The following table shows a variety of our available services:

Table 4: Kubota's Available Services

Service	Note
Periodical technical support	Monthly, Quarterly, Annually
24/7 phone support	Always available
SCADA monitoring	Weekly, Monthly, Quarterly
Periodical site visit	Quarterly, Semi-annually, Annually
Membrane inspection	Annual, Semi-annual, 3x per year
Membrane protection (10 year contract)	Select annual or semi-annual inspections
Program (SCADA, etc.) update	Based on hydraulic changes, such as increases in flow or changes in operation.

Appendix A

For additional clarity, the following pages are a copy of the 90% P&IDs, provided by Parametrix on January 3, 2018, which Kubota has highlighted to depict Kubota's scope of supply.

HMI

LOCAL CONTROL PANEL (LCP-2000)

LOCAL CONTROL PANEL (LCP-2023 & 2014)

FIELD PROCESS AND CONTROL

LC 2220 · FC 2130 · YC 2131 · YC 2127 · YC 2227 · YC 2231 · FC 2130

(2) (9) · (3) · (2) (3) · (2) · (2) (3) · (2) · (3)

PT 2134 · PE 2134

P205 | A BLOWER AIR TO MBR #1

12" PA

PLANT DRAIN SYSTEM FROM MBR EFFLUENT HEADER MBR #1, 3 & 2

LSHH 2227 · LSH 2227 · LSL 2227 · LSLL 2227 · LSLL 2228

REPLACE EXISTING PUMPS, VALVES, AND PIPE

PLANT DRAIN SYSTEM TO HEADWORKS/ SCREENINGS

PLANT DRAIN PUMP STATION

LOR HS 2227 · M · P-2225 PLANT DRAIN SUMP PUMP #1

LOR HS 2228 · M · P-2226 PLANT DRAIN SUMP PUMP #2

FIT 2133 · FE 2133 · M · 12" PA

ZSO 2131 · ZSC 2131 · M · FCV-2131

VFD-2127 HMI HS 2127

PS 2135 · HOA HS 2128 · M · TSH 2129 · PSH 2130 · LCP-2125

TSH 2140 · MBR #1 & #3 AIR BLOWER #1 ME-2125 · PSH 2136 · PI 2136

SOUND ENCLOSURE

VFD-2227 HMI HS 2227

PS 2235 · HOA HS 2228 · M · TSH 2229 · PSH 2230 · LCP-2200

TSH 2240 · MBR #1 & #3 AIR BLOWER #3 ME-2200 · PSH 2236 · PI 2236

ZSO 2231 · ZSC 2231 · M · FCV-2231

FIT 2233 · FE 2233 · M · PT 2234 · PE 2234 · 12" PA · BLOWER AIR TO MBR #3

12" PA · V-2241 · P202 | C AIR CROSS OVER TO/FROM AIR BLOWERS #2 & 4

NOTE:

1. NEW EQUIPMENT AND MATERIALS ARE SHOWN IN RED LINES. REFER TO CIVIL, STRUCTURAL, MECHANICAL, ELECTRICAL AND INSTRUMENTATION DRAWINGS FOR AN ACCURATE AND SCALED REPRESENTATION OF PIPING AND DETAILS INCLUDED IN THE PROJECT CONSTRUCTION.

= Kubota Scope

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REVISIONS	DATE	BY

DESIGNED A. MAAS/A. STOKES
DRAWN D. PETERSON/J. VONDERAHE
CHECKED L. ROSCOE
APPROVED

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME PS1598102-P201
JOB No. 216-1598-102
DATE JANUARY 2018

PROCESS ONLY — ALLAN MAAS — STATE OF WASHINGTON — 21045 — REGISTERED PROFESSIONAL ENGINEER

INSTRUMENTATION ONLY — ARTHUR D. STOKES — STATE OF WASHINGTON — 34736 — REGISTERED PROFESSIONAL ENGINEER

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WWW.PARAMETRIX.COM

PROJECT NAME
THE CONSOLIDATED BOROUGH OF QUIL CEDA VILLAGE
MBR TREATMENT FACILITY UPGRADE
TULALIP, WASHINGTON

P&ID
PLANT DRAIN PS AND MBR #1 & #3 PROCESS AIR BLOWERS

DRAWING NO.
X OF XX

P201

HMI

LOCAL CONTROL PANEL (LCP-2000)

LOCAL CONTROL PANEL (LCP-2023 & 2014)

FIELD PROCESS AND CONTROL

FC 2330 | YC 2331 | YC 2327 | YC 2427 | 2431 2231 | FC 2330

(2) (3) (2) (2) (3) (2) (3)

VFD-2327 STOP HS 2327 | PS 2335 | HOA (2) | HS 2328 | X 2329 | X 2330 | M-2128 | TSH 2340 | MBR #2 & #4 AIR BLOWER #2 ME-2325 | PSH 2336 | PI 2338 | LCP-2325 | SOUND ENCLOSURE

VFD-2427 STOP HS 2427 | PS 2435 | HOA (2) | HS 2428 | X 2429 | X 2430 | TSH 2440 | MBR #2 & #4 AIR BLOWER #4 ME-2400 | PSH 2436 | PI 2438 | LCP-2425 | SOUND ENCLOSURE

PT 2334 | PE 2334 | 12" PA | BLOWER AIR TO MBR #2

ZSO 2331 | ZSC 2331 | FIT 2333 | FE 2333 | M | 12" PA | FCV-2331

ZSO 2431 | ZSC 2431 | M | FCV-2431 | FIT 2433 | FE 2433 | PT 2434 | PE 2434 | 12" PA | B P206 BLOWER AIR TO MBR #4

12" PA | P201 C AIR CROSS OVER TO/FROM AIR BLOWERS #1 & 3

SV-2113 S | W3 | INTERVAL TIMER | P-TRAP PRIMER STATION

NOTE:

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JOB No. 216-1598-102
DATE JANUARY 2018

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THE CONSOLIDATED BOROUGH OF QUIL CEDA VILLAGE
MBR TREATMENT FACILITY UPGRADE
TULALIP, WASHINGTON

P&ID
MBR #2 & #4 PROCESS AIR BLOWERS

DRAWING NO. X OF XX
P202

PATH: U:\PSO\Projects\Clients\1598-TulalipTribes\216-1598-102 MBR Upgrade\99Svcs\CADD\DWG
PLOTTED BY: peterden DATE: Wednesday, January 3, 2018 3:32:11 PM
LAYOUT: P202

HMI

LOCAL CONTROL PANEL LCP 2000

LOCAL CONTROL PANEL LCP 2023

FIELD PROCESS AND CONTROL

LCP 2014

LCP 2023

FC 2101

(2) (2) (3)

VFD-2175 HIM HS 2175

VFD-2150 HIM HS 2150

VFD-2106 HIM HS 2106

P204 M CONNECTION TO MBR #2 & #4 REC

16" REC

16" REC

BLIND FLANGE W/DRAIN

4"

V-2109

RECYCLE MIXED LIQUOR TO POST MBR AND ANOXIC TANKS #1 & #2

4" WS

WASTE SLUDGE TO LOADOUT

V-2110

ARV 2100

PI 2102

HOA HS 2100

8" REC

V-2107

SAMPLE

V-2108

P-2100 MIXED LIQUOR RECYCLE PUMP #1

10" REC

V-2105

FIT 2104

FE 2104

VENT

12" REC

V-2522

P205 D RECYCLE MIXED LIQUOR FROM MBR #1

ARV 2150

PI 2152

HOA HS 2150

8" REC

V-2179

SAMPLE

V-2178

P-2150 MIXED LIQUOR RECYCLE BACK-UP PUMP #1 & #3

10" REC

V-2180

V-2182

12"

V-2183

FIT 2111

FE 2111

VENT

12" REC

V-2722

RECYCLE MIXED LIQUOR FROM MBR #3

ARV 2175

PI 2177

HOA HS 2175

8" REC

V-2185

V-2186

SAMPLE

MIXED LIQUOR RECYCLE PUMP #3

P-2175

V-2184

10" REC

12" REC

V-2132

RECYCLE MIXED LIQUOR CROSS OVER

PG

ROTO METER

PRV-100

ROTO METER

ROTO METER

NOTE:

1. NEW EQUIPMENT AND MATERIALS ARE SHOWN IN RED LINES. REFER TO CIVIL, STRUCTURAL, MECHANICAL, ELECTRICAL AND INSTRUMENTATION DRAWINGS FOR AN ACCURATE AND SCALED REPRESENTATION OF PIPING AND DETAILS INCLUDED IN THE PROJECT CONSTRUCTION.

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DESIGNED A. MAAS/A. STOKES
DRAWN D. PETERSON/J. VONDERAHE
CHECKED L. ROSCOE
APPROVED

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FILE NAME PS1598102-P203
JOB No. 216-1598-102
DATE JANUARY 2018

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PROJECT NAME
THE CONSOLIDATED BOROUGH OF QUIL CEDA VILLAGE
MBR TREATMENT FACILITY UPGRADE
TULALIP, WASHINGTON

P&ID
MBR #1 & #3 MIXED LIQUOR RECYCLE PUMPS

DRAWING NO.
X OF XX

P203

HMI

LOCAL CONTROL PANEL LCP 2000

LOCAL CONTROL PANEL LCP 2014

LCP 2023

LCP 2014

FIELD PROCESS AND CONTROL

FC 2301

(2) (2) (3) (2) (2) (3) (2) (2) (3)

P203 M CONNECTION TO MBR #1 & #3 REC

RECYCLE MIXED LIQUOR TO POST MBR AND ANOXIC TANKS #1 & #2

BLIND FLANGE W/DRAIN

4" V-2309

VFD-2375 STOP HS 2375

VFD-2350 STOP HS 2350

VFD-2306 STOP HS 2306

V-2307

ARV 2300

PI 2302

HOA HS 2300

M-2300

P-2300 MIXED LIQUOR RECYCLE PUMP #2

PI 2303

FIT 2304 FE 2304

VENT

SAMPLE

12" REC V-2422 RECYCLE MIXED LIQUOR FROM MBR #2

E-STOP

HS 2312 HS 2312 LSO 2312 LSC 2312

LCP-2325

M-2312

FIT 2311 FE 2311

4" WS

8" REC V-2308

10" REC V-2305

V-2382

V-2379

ARV 2350

PI 2352

V-2378

SAMPLE

HOA HS 2350

M-2150

P-2350 MIXED LIQUOR RECYCLE BACK-UP PUMP #2 & #4

PI 2351

10" REC V-2380

12"

V-2383

SLUDGE LOADOUT PAD

V-2312

WASTE SLUDGE FROM MBR #1 & #4

V-2310

V-2385

ARV 2375

PI 2377

HOA HS 2375

PI 2376

8" REC V-2386

SAMPLE

MIXED LIQUOR RECYCLE PUMP #4

P-2375

V-2384

10" REC

FIT 2313 FE 2313

VENT

12" REC M P206 E RECYCLE MIXED LIQUOR FROM MBR #4

V-2622

12" REC V-2314

RECYCLE MIXED LIQUOR CROSS OVER

NOTE:

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PROCESS ONLY

ALAN MAAS STATE OF WASHINGTON 21076 REGISTERED PROFESSIONAL ENGINEER

INSTRUMENTATION ONLY

ARTHUR G. STOKES STATE OF WASHINGTON 94738 REGISTERED PROFESSIONAL ENGINEER

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	REVISIONS	DATE	BY

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FILE NAME PS1598102-P204
JOB No. 216-1598-102
DATE JANUARY 2018

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PROJECT NAME
THE CONSOLIDATED BOROUGH OF QUIL CEDA VILLAGE
MBR TREATMENT FACILITY UPGRADE
TULALIP, WASHINGTON

P&ID
MBR #2 & #4 MIXED LIQUOR RECYCLE PUMPS

DRAWING NO. X OF XX

P204

PATH: U:\PS0\Projects\Clients\1598-TulalipTribes\216-1598-102 MBR Upgrade\99Svcs\CADD\DWG
PLOTTED BY: peterden DATE: Wednesday, January 3, 2018 3:31:00 PM
LAYOUT: P204

HMI

LOCAL CONTROL PANEL (LCP-2000)

LOCAL CONTROL PANEL (LCP-2014)

FIELD PROCESS AND CONTROL

LC 2508

YC 2501

CONTROL ROOM MCP-001

(2) (5) (3)

NOTE:

1. NEW EQUIPMENT AND MATERIALS ARE SHOWN IN RED LINES. REFER TO CIVIL, STRUCTURAL, MECHANICAL, ELECTRICAL AND INSTRUMENTATION DRAWINGS FOR AN ACCURATE AND SCALED REPRESENTATION OF PIPING AND DETAILS INCLUDED IN THE PROJECT CONSTRUCTION.

LT 2521 LE 2521

VENT — 18" CLS RESERVOIR — VENT

2" CLS 2" CLS

2"

P206 N CLS HEADER TO MBR #2 & #4

CLS FROM GENERATION PLANT

FIT 2517 FE 2517 M

PT 2517 PE 2517

LIT 2508

TURBIDITY METER X-2504

TURBIDITY METER X-2505

LE 2508

Level Switch Low

2" CLS

8" UPPER CARTRIDGE PERMEATE COLLECTOR

8" LOWER CARTRIDGE PERMEATE COLLECTOR

VENT

CLS HEADER TO MBR #3

M-2506 V-2506

FROM PRE-MEMBRANE AERATION TANK

V-2523 V-2524 V-2525 V-2526 V-2527 V-2528 V-2529 V-2530 V-2531 V-2532 V-2533 V-2534 V-2535 V-2536 V-2537 V-2538

SAMPLE

MBR 1J MBR 1A MBR 1K MBR 1B MBR 1L MBR 1C MBR 1M MBR 1D MBR 1N MBR 1E MBR 1P MBR 1F MBR 1Q MBR 1G MBR 1R MBR 1H

MEMBRANE BIOREACTOR #1 TANK

TK-2500

OVERFLOW TO MBR #3

REC INFLUENT BOX

4" DRAIN

V-2522

12" REC

D P203 RECYCLE MIXED LIQUOR TO RECYCLE PUMPS #1 & #3

SAMPLE/ DRAIN

10" PA

MBR1

FSI 2509 FSI 2510 FSI 2511 FSI 2512 FSI 2513 FSI 2514 FSI 2515 FSI 2516

V-2509 V-2510 V-2511 V-2512 V-2513 V-2514 V-2515 V-2516

F P207 MBR #1 PERMEATE MAIN

12" PA

P201 A AIR FROM BLOWERS

ZSO 2503 ZSC 2503

SAMPLE

V-2503

20" MBRI

20" MBRI

INFLUENT TO MBR #3

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ALAN MAAS 27045 STATE OF WASHINGTON REGISTERED PROFESSIONAL ENGINEER

INSTRUMENTATION ONLY

HENRY S. JONES 34736 STATE OF WASHINGTON REGISTERED PROFESSIONAL ENGINEER

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DESIGNED A. MAAS
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FILE NAME P51598102-P205
JOB No. 216-1598-102
DATE JANUARY 2018

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PROJECT NAME
THE CONSOLIDATED BOROUGH OF QUIL CEDA VILLAGE
MBR TREATMENT FACILITY UPGRADE
TULALIP, WASHINGTON

P&ID MBR #1

DRAWING NO. X OF XX

P205

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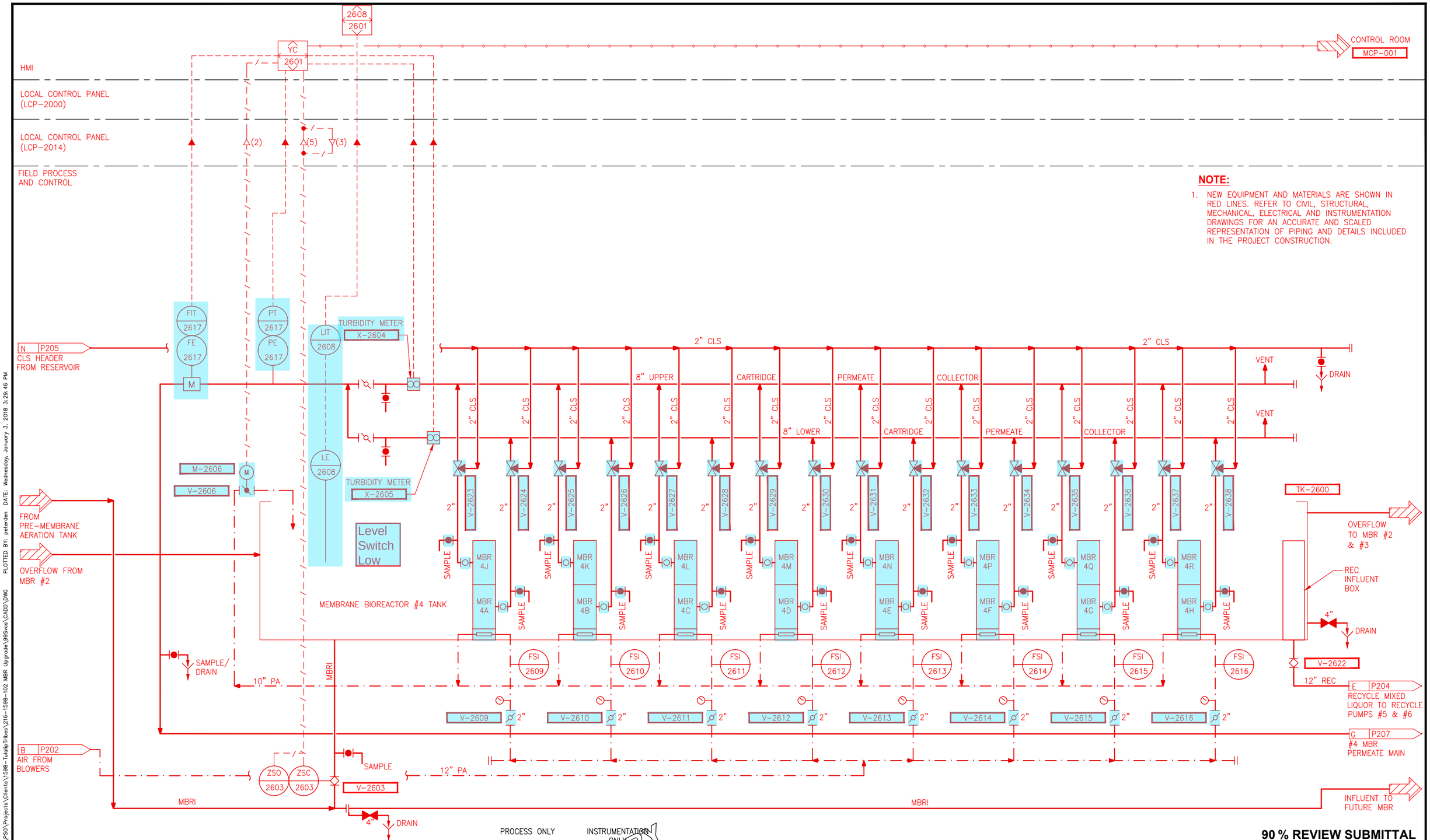

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APPROVED

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JOB No. 216-1598-102
DATE JANUARY 2018

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INSTRUMENTATION ONLY — HENRY S. BOKER — STATE OF WASHINGTON — 34736 — REGISTERED PROFESSIONAL ENGINEER

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QUIL CEDA VILLAGE
MBR TREATMENT FACILITY UPGRADE
TULALIP, WASHINGTON

P&ID
MBR #4

DRAWING NO.
X OF XX
P206

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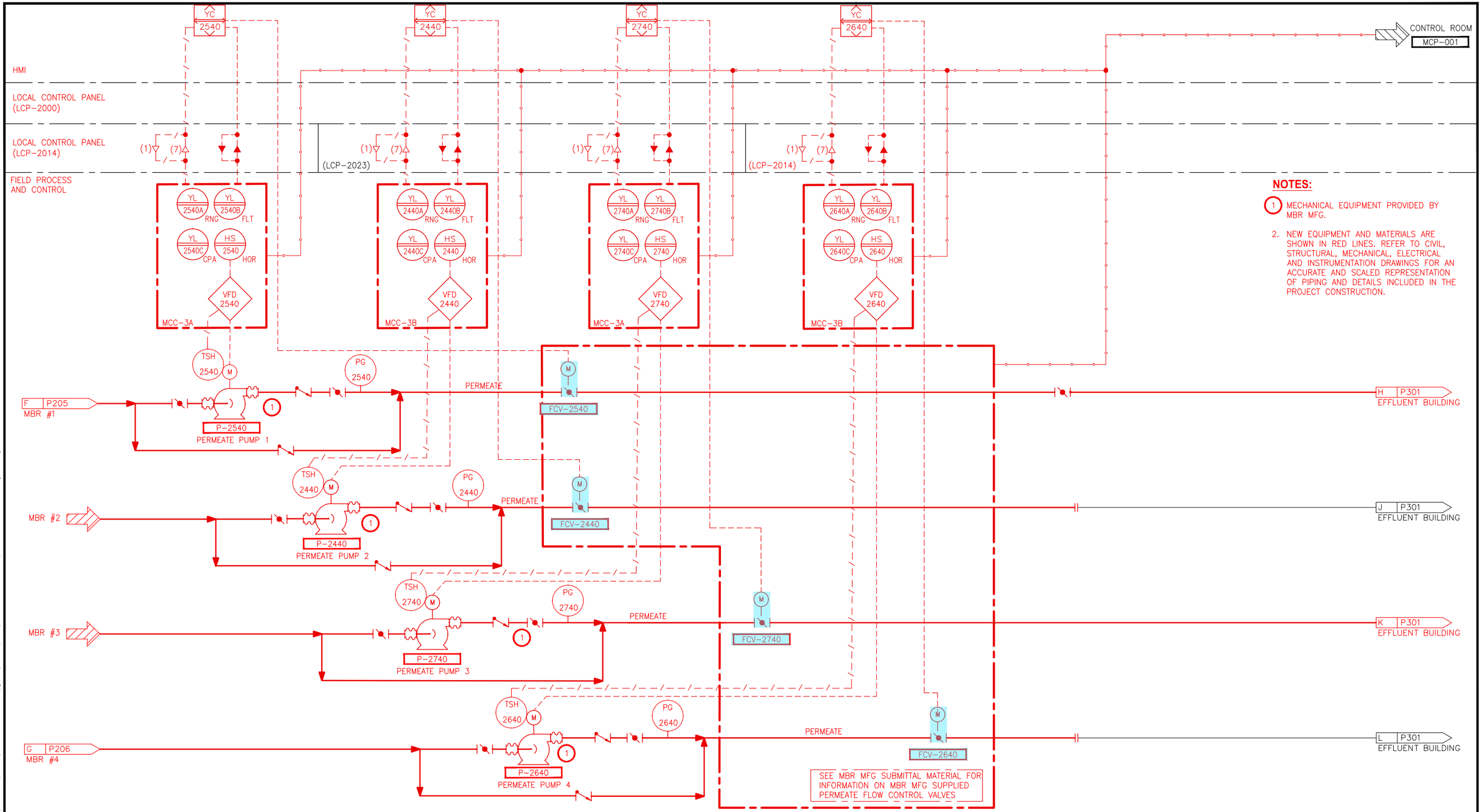
LAYOUT: P206



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LAYOUT: P207

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DESIGNED A. MAAS
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APPROVED

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JOB No. 216-1598-102
DATE JANUARY 2018

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PROJECT NAME
THE CONSOLIDATED BOROUGH OF QUIL CEDA VILLAGE
MBR TREATMENT FACILITY UPGRADE
TULALIP, WASHINGTON

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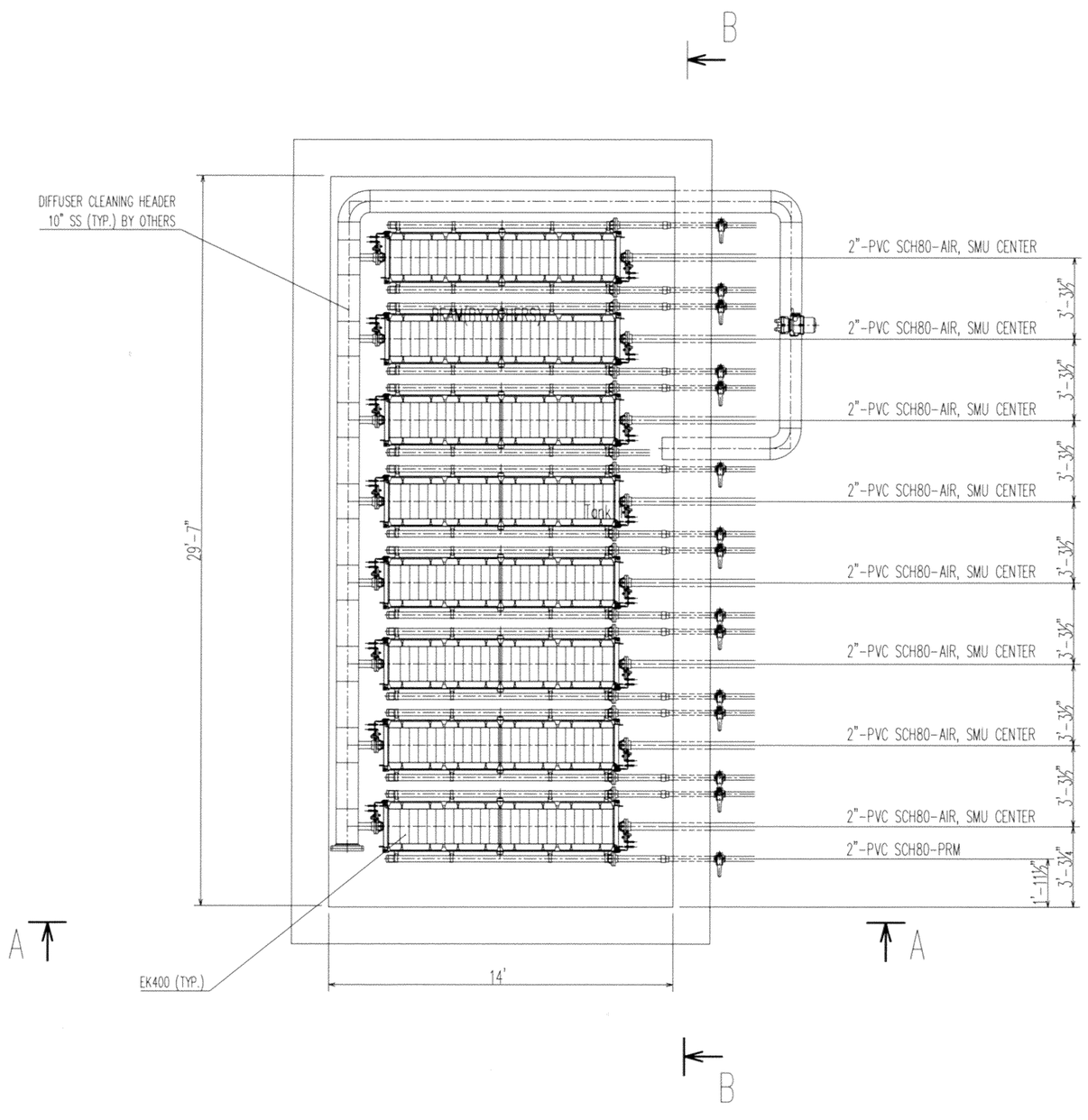
P&ID
PERMEATE PUMPS

DRAWING NO. X OF XX
P207

11-16



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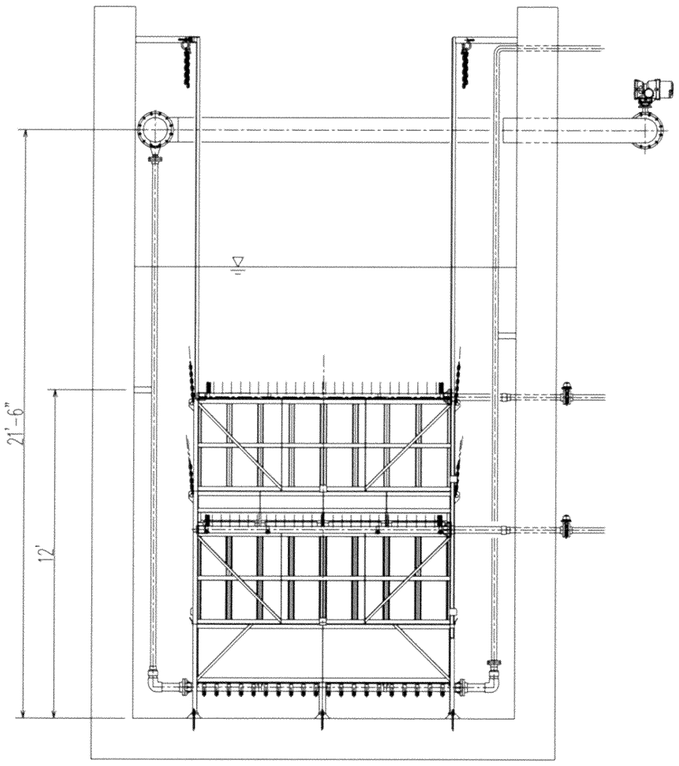
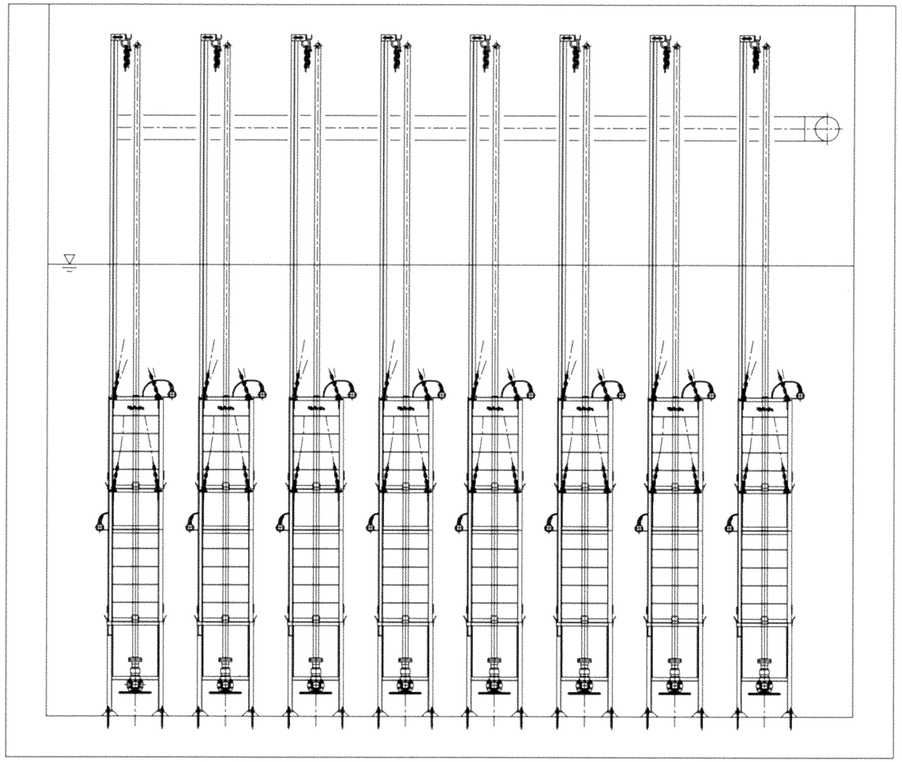
For Earth, For Life
Kubota
Kubota Membrane USA Corp. 11807 North Creek Parkway S. Suite B109
Bothell, WA 98011 USA Tel; +1 425 898 2853

		DATE	△	REVISIONS	DATE	BY	△	REVISIONS	DATE	BY
DRAWN BY	SACHIKO K.	8/9/17								
DESIGNED BY										
CHECKED BY										
APPROVED BY										

PROJECT NAME/No.	***
TITLE	MBR PLAN DWG
SCALE	AS SHOWN
SHEET	1 OF X
DWG No.	1



SECTION A - A



SECTION B - B

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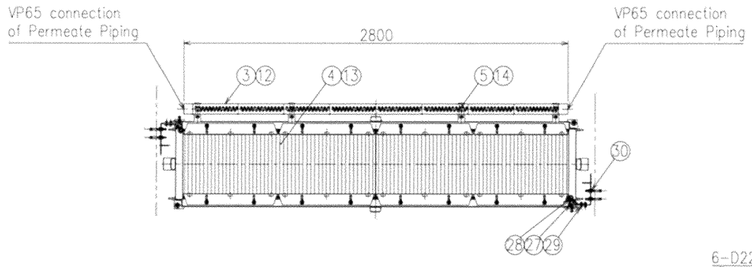
DRAWN BY	SACHIKO K.	8/9/17								
DESIGNED BY										
CHECKED BY										
APPROVED BY										

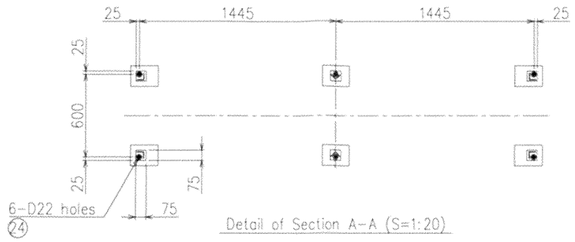
PROJECT NAME/No.	SCALE AS SHOWN
*	SHEET 1 OF X
TITLE	DWG No.
MBR TANK DWG - SECTION A AND SECTION B	*

CAREER
SP-10-2146

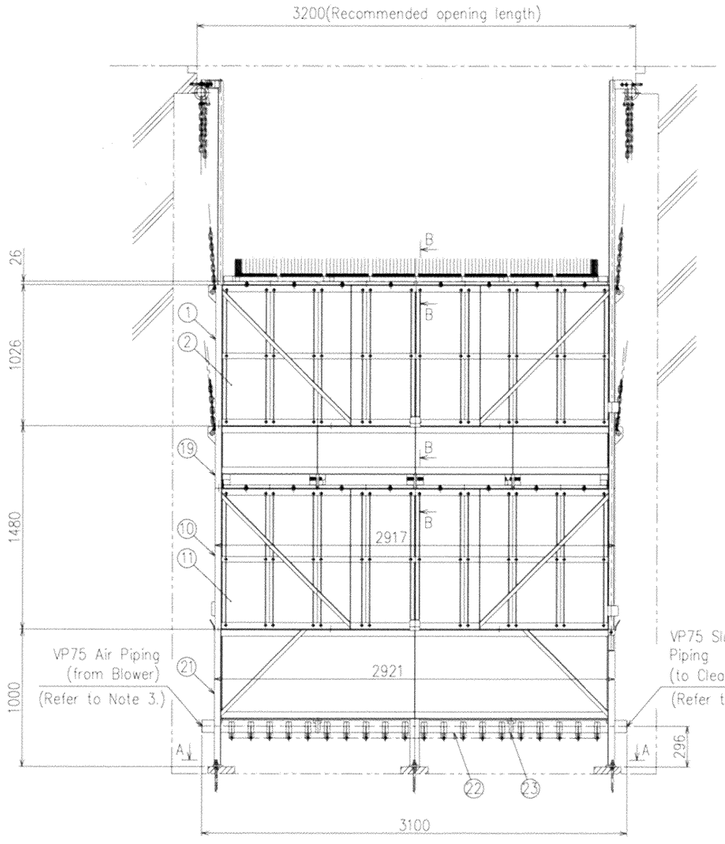
MARKS	ALTERATION	DATE	DESIGNED BY	APPROVED BY
1				
2				
3				
4				

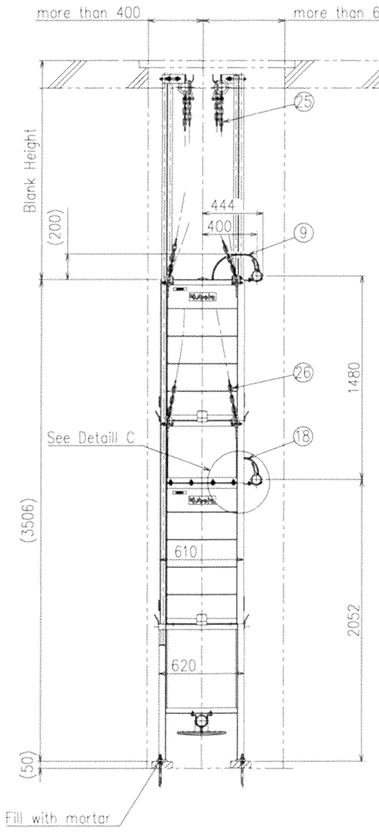
8-7

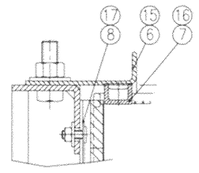




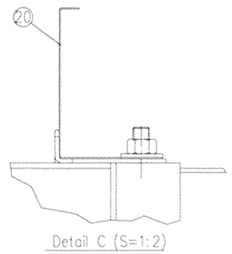
Detail of Section A-A (S=1:20)







Detail of Section B-B (S=1:2)



Detail C (S=1:2)

Notes:
1. More than 2 m of effective free height is required to lift up the Membrane Case.
2. Carefully read the notices in the "Installation Drawings" of this model.
3. The air and the sludge flushing piping can be connected to Diffuser on the opposite way.

Product Weight

Model	weight (kg)	
	dry	wet (Max)
Membrane Case MS200	830	1630
Membrane Case MK200	900	1700
Diffuser Case DES200	120	

PARTS NO.	NAME OF PARTS	MATERIALS	NO.REQD.	REMARKS
30	Anchor Bolt	SUS304	4	M12x120L Customer's provision
29	Hexagon Bolt, Nut	SUS304	4	M10x30L,2PW Optional
28	Stabilizer Pipe	SUS304	2	Optional
27	Guide Pipe	SUS304	2	Optional
26	Lifting Chain (Lower case)	SUS304	4	Optional
25	Lifting Chain (Upper case)	SUS304	4	Optional
Guide and Chain Set				
24	Anchor Bolt with Chemical setter	SUS304	6	M16x230L Customer's provision
Chemical Anchor				
23	Diffuser Band	SUS304	5	
22	Diffuser	PVC/ABS	1	VP75
21	Diffuser Case Frame	SUS304	1	
Diffuser Case				DES200R2
20	Guide Plate	SUS304	4	
19	Intermediate Case Frame	SUS304	1	
18	Tube	PUR	200	ø8xø10.5x500L
17	Fixing Bar	SUS304	32	
16	Retaining Rubber	EPDM	8	50-cartridge mount x 8 pcs
15	Retaining Plate	SUS304	8	50-cartridge mount x 8 pcs
14	Manifold Band	SUS304	4	
13	Membrane Cartridge	ABS	200	
12	Manifold	ABS/PVC	1	equivalent to VP65
11	Panel	PVC	16	
10	Membrane Case Frame	SUS304	1	
Membrane Case (Lower Case)				MK200R2.1
9	Tube	PUR	200	ø8xø10.5x500L
8	Fixing Bar	SUS304	32	
7	Retaining Rubber	EPDM	8	50-cartridge mount x 8 pcs
6	Retaining Plate	SUS304	8	50-cartridge mount x 8 pcs
5	Manifold Band	SUS304	4	
4	Membrane Cartridge	ABS	200	H6
3	Manifold	ABS/PVC	1	equivalent to VP65
2	Panel	PVC	16	
1	Membrane Case Frame	SUS304	1	
Membrane Case (Upper Case)				MS200R2.1

TYPE: EK400R2.1-G
CUSTOMER:
TITLE: Assembly drawing of Membrane Unit EK400

Membrane Development and Eng. Group	APPROVED BY	CHECKED BY	DESIGNED BY	DRAWN BY
	Y.Oi	Y.Matsuzaki	K.Ishikawa	S.Kitayama

THIRD ANGLE | DATE: 2012. 6.15 | SCALE: 1:20
DWG NO.: SP-12-2019
ORDER NO.:
FILE NO.: U6.30

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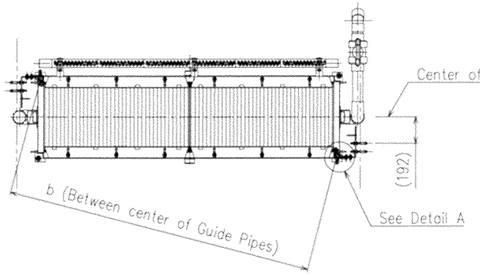
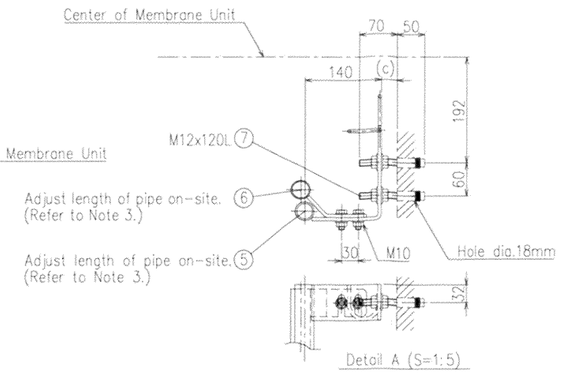
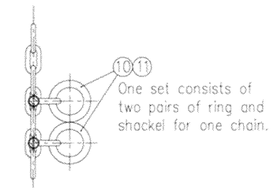




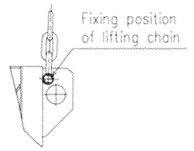
Detail A (S=1:5)



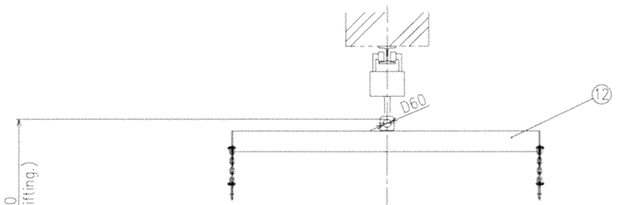
One set consists of two pairs of ring and shackel for one chain.

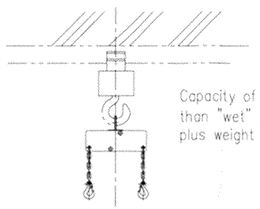
Detail B (S=1:5)

(When two step lifting is adopted, another lifting device to be prepared by customer.)

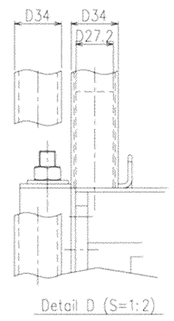


Detail C (S=1:5)

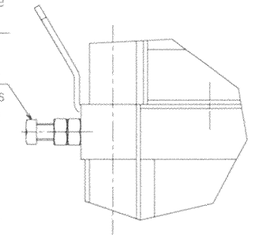




Capacity of lifting facilities to be more than "wet" weight of Membrane Case plus weight of Lifting Tool.

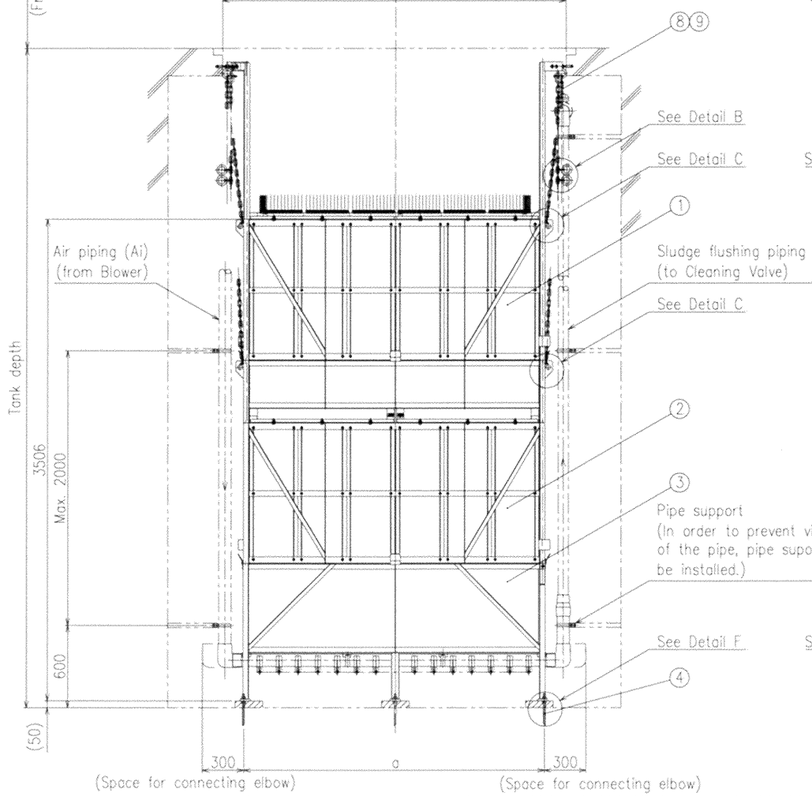


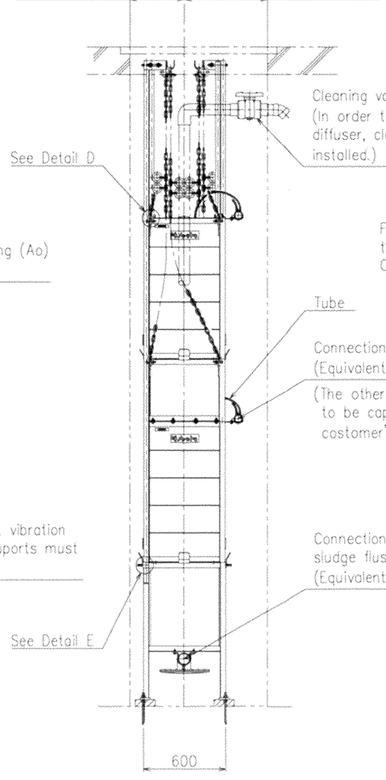
Detail D (S=1:2)

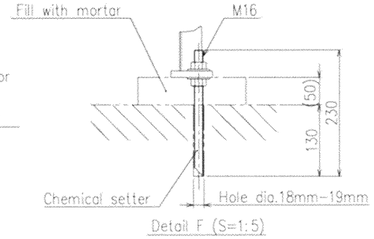


Fasten bolts and nuts tightly after installing Guide Pipe.

Detail E (S=1:2)







Detail F (S=1:5)

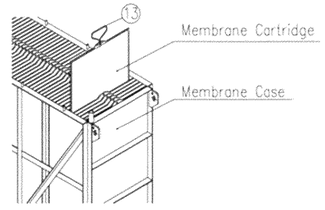


Figure to pick up a Membrane Cartridge

Material
SUS304
SUS316

Model	Recommended opening length	Chemical anchor		Dimension b	Dimension c	Permeate piping	Air piping	Sludge flushing piping	Weight (kg)				Lifting Tool
									Membrane Case				
		Pcs	Dimension a						Upper Case		Lower Case		
							Ai	Ao	dry	wet	dry	wet	
EK300R2.1	2500	6	2190	2230	30	VP50	VP75	VP65	620	1220	660	1260	60
EK400R2.1	3200	6	2890	2920	29	VP65	VP75	VP75	830	1630	900	1700	110

13	Hand Hook	SUS304	1	Optional
12	Lifting Tool	SS400 or equivalent	1	Optional
11	Hanger Ring (Lower case)	SUS	4	Optional
10	Hanger Ring (Upper case)	SUS	4	Optional
9	Lifting Chain (Lower case)	SUS	4	Optional
8	Lifting Chain (Upper case)	SUS	4	Optional
7	Anchor Bolt	SUS	4	Customer's provision
6	Stabilizer Pipe	SUS	2	Optional
5	Guide Pipe	SUS	2	Optional
4	Anchor Bolt with Chemical setter	SUS etc.	6	Customer's provision
3	Diffuser Case	SUS/PVC/ABS	1	
2	Membrane Case (Lower Case)	SUS/PVC/ABS etc.	1	
1	Membrane Case (Upper Case)	SUS/PVC/ABS etc.	1	
PARTS NO.	NAME OF PARTS	MATERIALS	NO.REQD.	REMARKS

TYPE: EK***R2.1-G
(***refers to num. of Membrane Cartridges.)

CUSTOMER

TITLE: Installation drawing of Membrane Unit

Membrane Development and Eng. Group	APPROVED BY	CHECKED BY	DESIGNED BY	DRAWN BY
	Y.Oi	Y.Matsuzaki	K.Ishikawa	S.Kitayama

THIRD ANGLE | DATE: 2012. 7. 4 | SCALE: 1:20

DWG NO. SP-12-2048 (2)

ORDER NO. | FILE NO. U6.30

KUBOTA Corporation

CAREER SP-10-2153 (0)

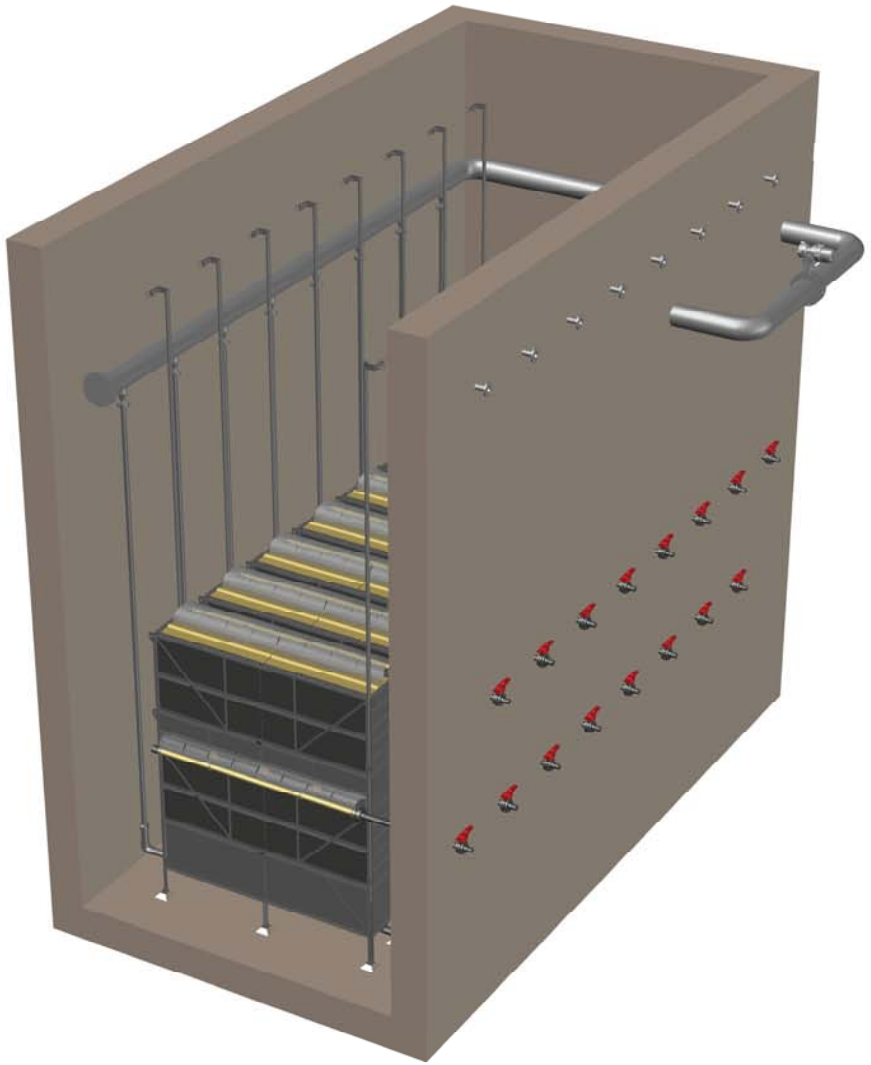
MARKS	ALTERATION	DATE	DESIGNED BY	APPROVED BY
1				
2				
3				
4				
5				

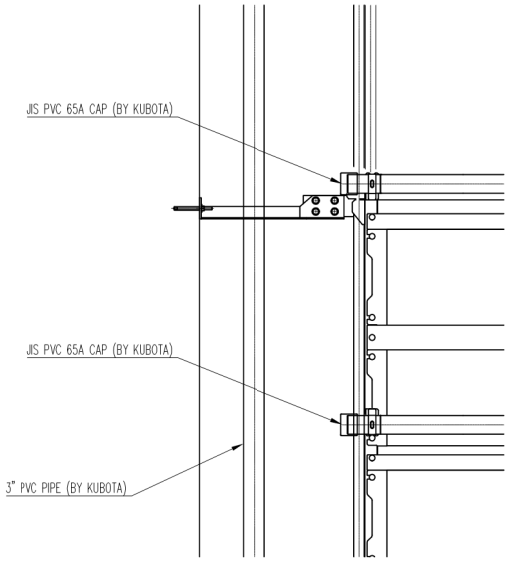
Notes:
1. Typical outline of EK300R2.1-G is shown in this drawing. Other models apply this drawing; Each model may be different in outline and components.
2. Diffuser Case needs to be installed horizontally.
3. Adjust length of Guide Pipe(⑤) / Stabilizer Pipe(⑥) / Lifting Chain (⑧⑨) on-site. Cutter to be prepared. Cut four Lifting Chains to be equal in length. For detail, refer to "Installation Drawings of Guide and Chain (for type ES/EK)".
4. Membrane Case may float due to aeration. Install Stabilizer pipe to fix Membrane Case.
5. Install permeate piping not to obstruct Membrane Case lifting out of tank.
6. Permeate piping, air piping, sludge flushing piping, cleaning valve and pipe supports to be supplied by customer.

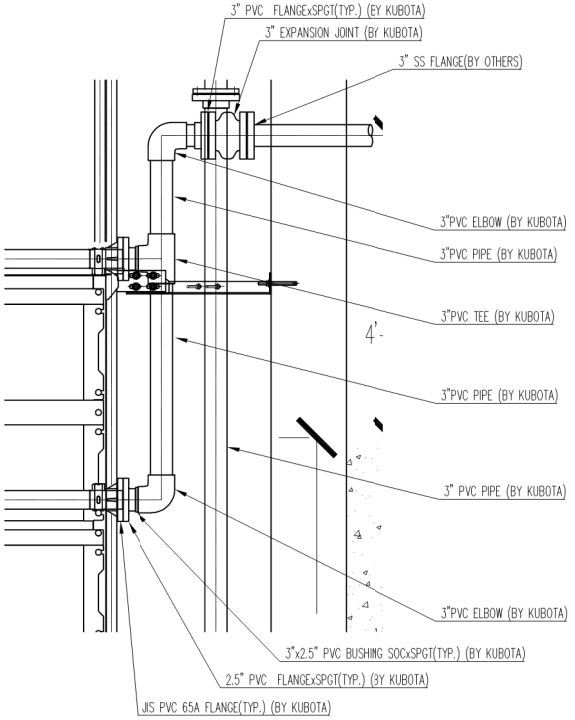
Prohibited

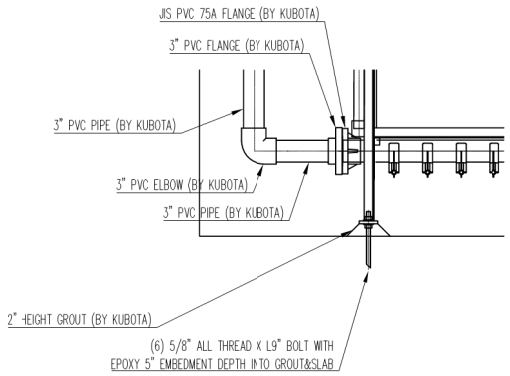
No Spark
1. Even a tiny spark would cause damage on Membrane Sheet resulting in leakage of suspended solids. Never expose Membrane Sheet to spark from grinders or welding.
2. Use fine proof sheet to avoid the risk of an exposure to the spark.

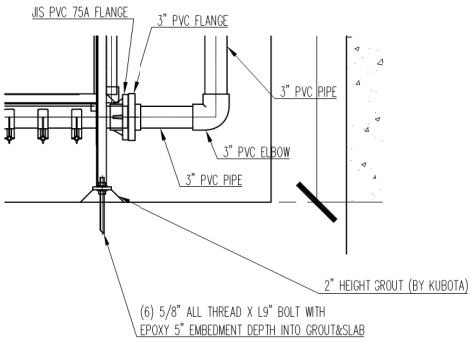
No Pressurized Injection
1. Never pressurize a Membrane Case, or it may break Membrane Sheet and/or a Membrane Case. Avoid the pressurized injection with pumps, etc.
2. Pour chemical solution to chemical pouring port when chemical cleaning is done. The pressure inside Membrane Sheet must be kept under 10kPa (about 1 meter water head).











General Notes

For Earth, For Life
Kubota

Kubota Membrane USA Cooporation
11807 North Creek Parkway S. Suite B109
Bothell, WA 98011 USA
Tel: +1 425 898 2653

No.	Revision/Issue	Date

Drawing Name

MBR TANK
IN BASIN PIPING DETAIL

Project Name and Address

WATER RECLAMATION PLANT

COWLITZ RESERVATION DEVELOPMENT

Area	Stamp
Drawing Number: M502-2	
Author: B MAST	

S-23- R1

REFERENCE ONLY

R - 3

CAREER				
MARKS	ALTERATION	DATE	DESIGNED BY	APPROVED BY
△				
△				
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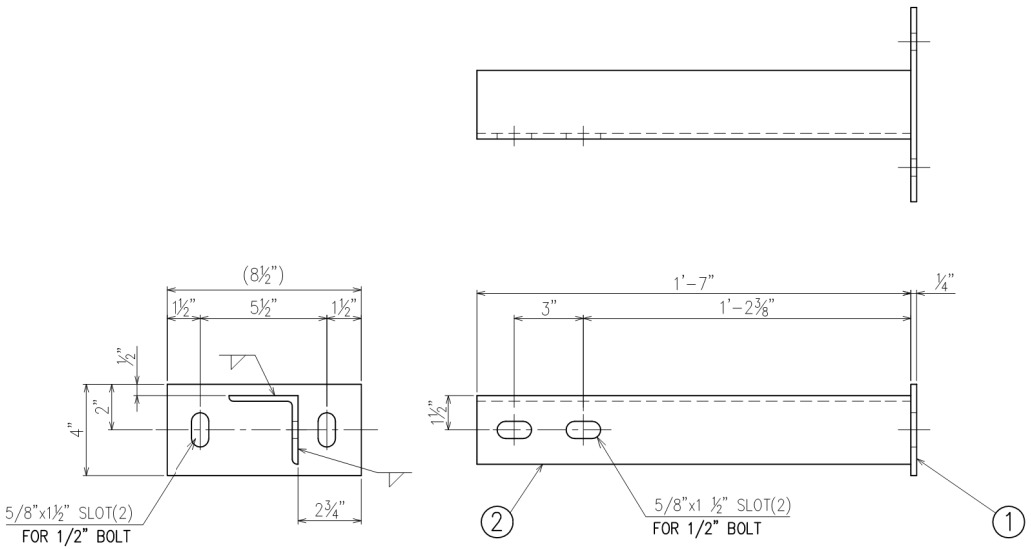


Shop Notes : (unless otherwise specified)

1. All dimensions are ±1/16.
2. Dimensions are to center lines of holes/slots.
3. All welding needs to be passivated
4. All burr shall be removed.

PARTS NO.	NAME OF PARTS	MATERIALS	NO.REQD.	lb[kg] MASS	REMARKS
2	ANGLE	304SS	1	8	3"x3"x1/4"x1'-7"LG
1	PLATE	304SS	1	2	8 1/2"x4"x1/4" THK

TYPE CUSTOMER

TITLE: GUIDE PIPE TOP SUPPORT FABRICATION DETAILS

Membrane Development and Eng. Grcup	APPROVED BY	CHECKED BY	DESIGNED BY	DRAWN BY	THIRD ANGLE	DATE	SCALE
			S.Kubo	S.Kitayama		2016.08.05	AS SHOWN

DWG NO. FB-1

KUBOTA Corporation

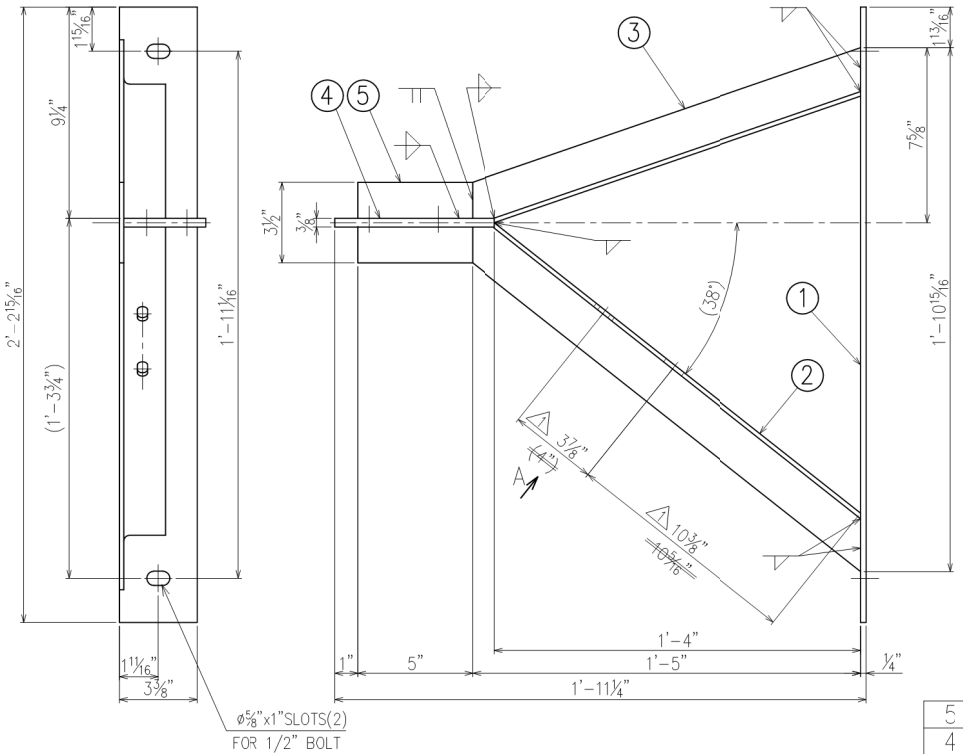
ORDER NO. FILE NO.

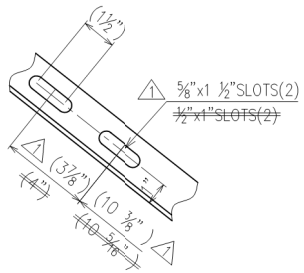
A3-in

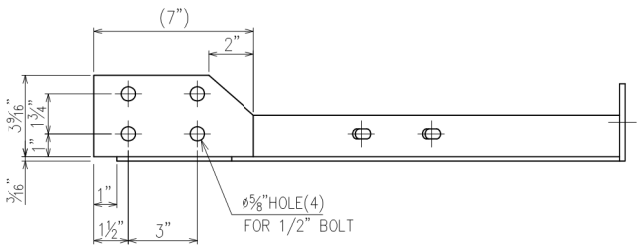
REFERENCE ONLY

R - 4

S-24- R1







CAREER				
MARKS	ALTERATION	DATE	DESIGNED BY	APPROVED BY
1				
2				
3				
4				

Shop Notes : (unless otherwise specified)

1. All dimensions are ±1/16.
2. Dimensions are to center lines of holes/slots.
3. All welding needs to be passivated
4. All burr shall be removed.

PARTS NO.	NAME OF PARTS	MATERIALS	NO.REQD.	lb[kg] MASS	REMARKS
5	PLATE	304 SS	1	–	3/16" THK
4	PLATE	304 SS	1	–	3/8" THK
3	ANGLE	304 SS	1	–	2"x2"x3/16"THK
2	ANGLE	304 SS	1	–	2"x2"x3/16"THK
1	PLATE	304 SS	1	–	3 3/8"x 2-2 15/16" x1/4"THK

TYPE

CUSTOMER

TITLE: GUIDE PIPE SUPPORT BRACE FABRICATION DETAILS

Membrane Development and Eng. Grcup	APPROVED BY	CHECKED BY	DESIGNED BY	DRAWN BY
			S.Kubo	S.Kitayama

THIRD ANGLE | DATE 2016.08.05 | SCALE AS SHOWN

DWG NO. FB-2

KUBOTA Corporation

ORDER NO. | FILE NO.

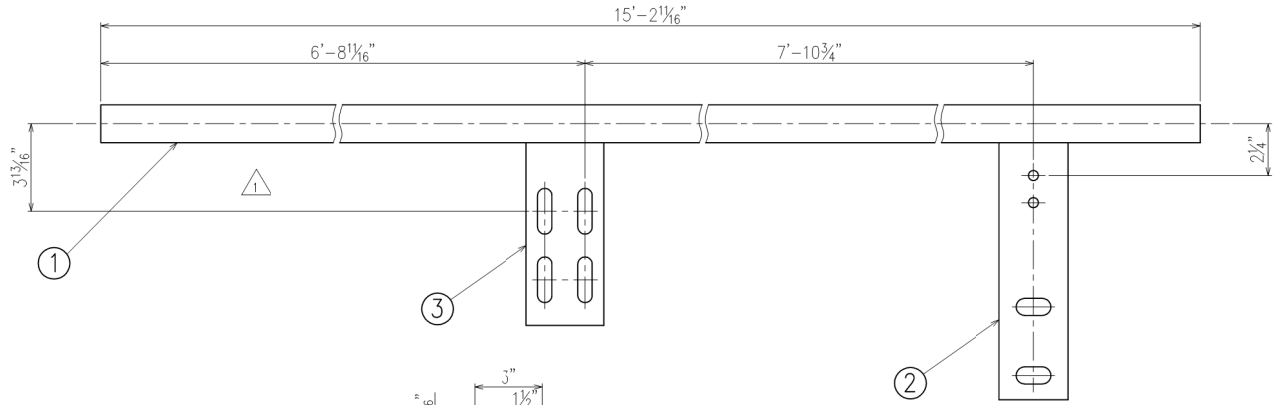
6 5 4 3 2 1 A3-in

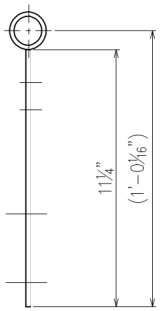
S-25- R1

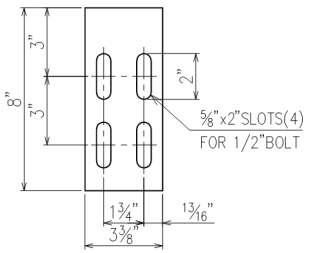
REFERENCE ONLY

R - 5

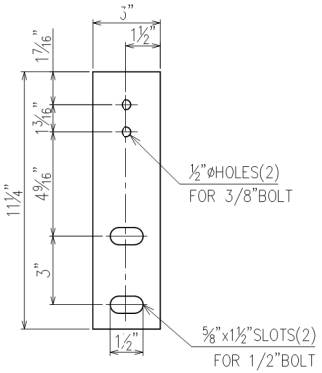
CAREER				
MARKS	ALTERATION	DATE	DESIGNED BY	APPROVED BY
1	Eliminate the 3rd lug	2014.7.30	Shingo	







DETAIL-PC.-3



DETAIL-PC.-2

Shop Notes : (unless otherwise specified)

1. All dimensions are ±1/16.
2. Dimensions are to center lines of holes/slots.
3. All welding needs to be passivated
4. All burr shall be removed.

PARTS NO.	NAME OF PARTS	MATERIALS	NO.REQD.	lb[kg] MASS	REMARKS
3	PLATE	304 SS	1		1/4"THK
2	PLATE	304 SS	1		1/4"THK
1	PIPE	304 SS	1		1 1/4"SCH 10 TYP

TYPE CUSTOMER

TITLE: SMU GUIDE PIPE (long) FABRICATION DETAILS

Membrane Development and Eng. Grcup	APPROVED BY	CHECKED BY	DESIGNED BY	DRAWN BY	THIRD ANGLE	DATE	SCALE
			S.Kubo	S.Kitayama		2016.08.05	AS SHOWN

DWG NO. FB-3

KUBOTA Corporation

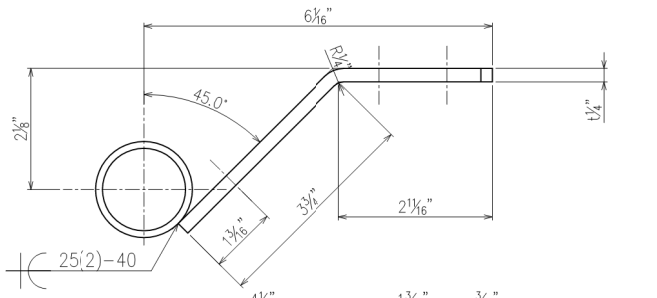
ORDER NO. FILE NO.

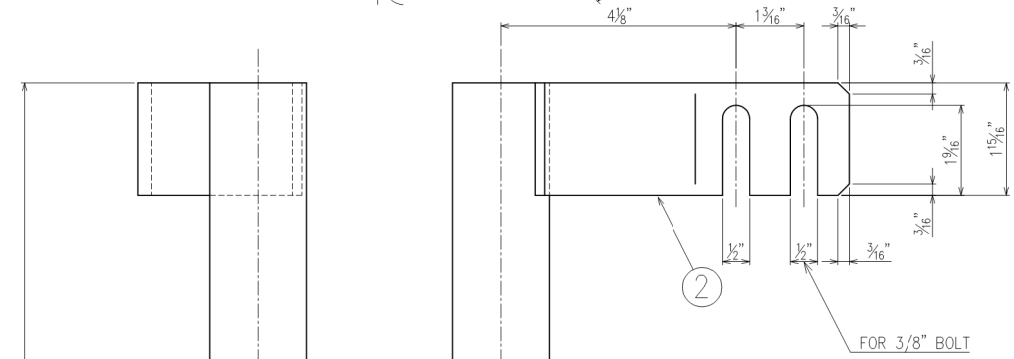
A3-in

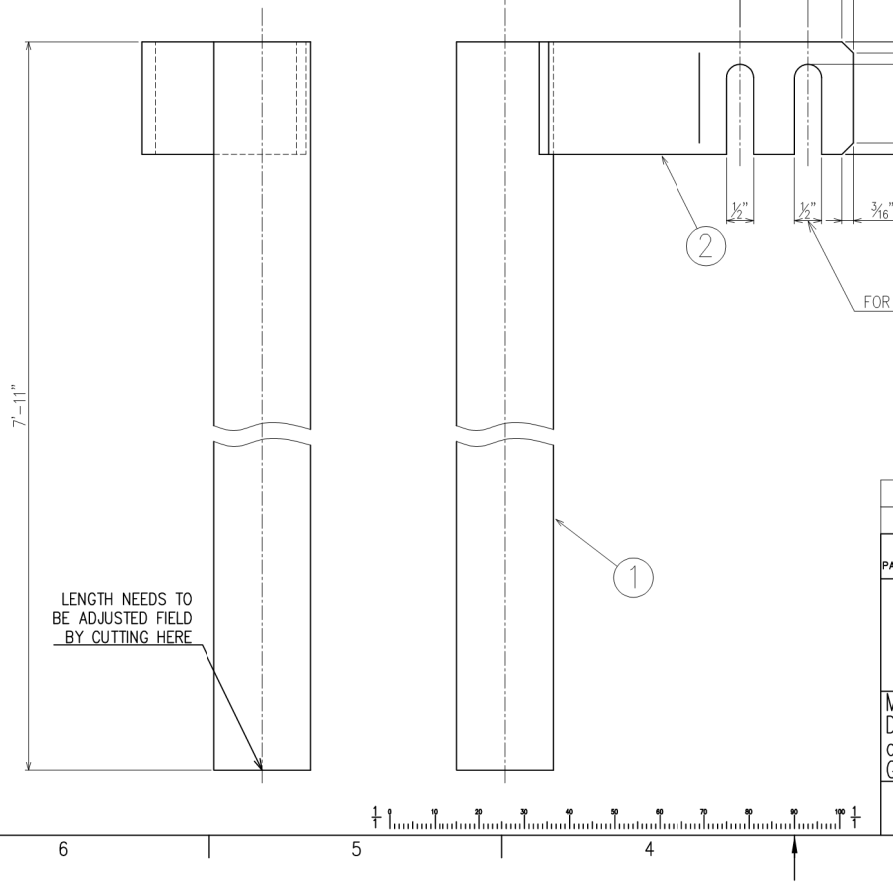
REFERENCE ONLY

S-26- R1

R - 6







MARKS	ALTERATION	DATE	DESIGNED BY	APPROVED BY

CAREER

Shop Notes : (unless otherwise specified)

1. All dimensions are ±1/16.
2. Dimensions are to center lines of holes/slots.
3. All welding needs to be passivated
4. All burr shall be removed.

PARTS NO.	NAME OF PARTS	MATERIALS	NO.REQD.	lb[kg] MASS	REMARKS
2	PLATE	304SS	1		
1	PIPE	304SS	1		1 1/4"SCH 10 TYP

TYPE CUSTOMER

TITLE: STABILIZER PIPE FABRICATION DETAILS

Membrane Development and Eng. Grcup	APPROVED BY	CHECKED BY	DESIGNED BY	DRAWN BY
			S.Kubo	S.Kitayama

THIRD ANGLE | DATE 2016.08.05 | SCALE AS SHOWN

DWG NO. FB-4

KUBOTA Corporation

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6 5 4 3 2 1 A3-in

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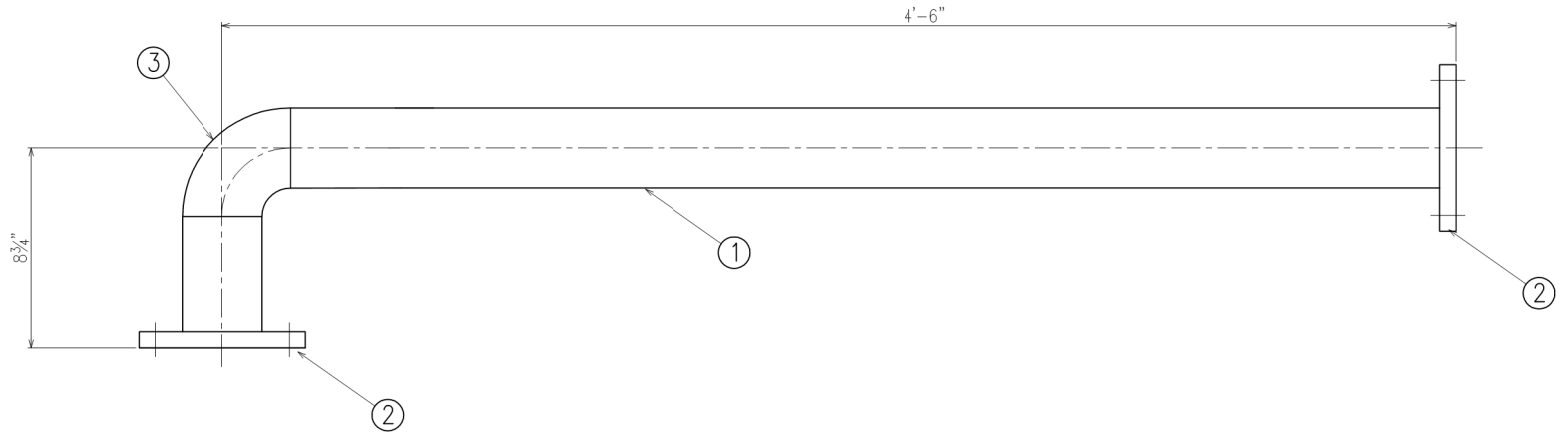
S-27- R1

REFERENCE ONLY

R - 7

CAREER				
MARKS	ALTERATION	DATE	DESIGNED BY	APPROVED BY
1	Eliminate the 3rd lug	2014.7.30	Shingo	



Shop Notes : (unless otherwise specified)

1. All dimensions are ±1/16.
2. Dimensions are to center lines of holes/slots.
3. All welding needs to be passivated
4. All burr shall be removed.
5. All welding in the factory shall use shielded arc, inert gas, MIG or TIG method. Filer wire shall be added to all welds to provide for a cross section equal to or greater than the parent metcl. Butt welds shall fully penetrate to the interior surface and gas shielding to interior and exterior of the joint shall be provided.

PARTS NO.	NAME OF PARTS	MATERIALS	NO.REQD.	lb[kg] MASS	REMARKS
3	3" ELBOW	304L SS	1		BUTT WELD, ASTM A774, SCH10S
2	3" FLANGE	304L SS	2		CL150
1	3" PIPE	304L SS	1		ASTM A774 SCH 10S

TYPE CUSTOMER

TITLE: SMU GUIDE PIPE (long) FABRICATION DETAILS

Membrane Development and Eng. Grcup	APPROVED BY	CHECKED BY	DESIGNED BY	DRAWN BY	THIRD ANGLE	DATE	SCALE
			S.Kubo	S.Kitayama		2016.08.05	AS SHOWN

DWG NO. FB-10

KUBOTA Corporation

ORDER NO. FILE NO.

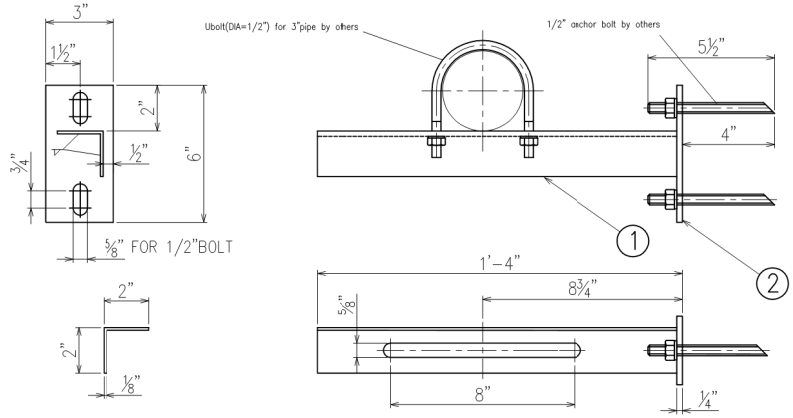
A3-in

S-28- R1

REFERENCE ONLY

R - 8

CAREER				
MARKS	ALTERATION	DATE	DESIGNED BY	APPROVED BY
1				



Shop Notes : (unless otherwise specified)

1. All dimensions are ±1/16.
2. Dimensions are to center lines of holes/slots.
3. All welding needs to be passivated
4. All burr shall be removed.

PARTS NO.	NAME OF PARTS	MATERIALS	NO.REQD.	lb[kg] MASS	REMARKS
2	PLATE	304 SS	1		3"X6"X1/4" THK
1	ANGLE	304 SS	1		2"X2"X1/8"THK

TYPE CUSTOMER

TITLE: SMU GUIDE PIPE (long) FABRICATION DETAILS

Membrane Development and Eng. Grcup	APPROVED BY	CHECKED BY	DESIGNED BY	DRAWN BY	THIRD ANGLE	DATE	SCALE
			S.Kubo	S.Kitayama		2016.08.05	AS SHOWN

DWG NO. FB-11

KUBOTA Corporation

ORDER NO. FILE NO.

A3-in

S-29- R1

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R - 9

KUBOTA Membrane USA Corporation

GENERAL TERMS & CONDITIONS

1. Precedence of Terms. These general terms and conditions shall apply to this Contract, except that provisions set forth on the face hereof shall take precedence over any inconsistent or contrary provisions set forth in these General Terms and Conditions. No conditions contrary to or in addition to those set forth in this General Terms and Conditions shall be binding upon the Seller unless expressly approved in writing by Seller. Performance by Seller shall not be construed as accepting any different or additional terms.

2. Quality and Quantity. Seller shall not be responsible for any damage to or deterioration in the quality or loss in weight or units of the Goods during transit or due to natural causes.

3. Shipment. Shipment within the time stipulated on the face hereto shall be subject to the availability of vessel's space. In case FCA or FOB INCOTERMS apply to this Contract and Buyer fails to obtain space in time to fulfill the stipulated shipment date, Buyer shall be responsible for all costs, expenses and damages resulting directly or indirectly therefrom, including, without limitation, all increases in freight and insurance charges, losses, and other damages incurred by Seller prior to or after such failure by Buyer. The date of the Bill of Lading or the Waybill shall be conclusive evidence of the shipment date.

4. Risk of Loss and Transfer of Title. Risk of loss or damage to the Goods shall pass from Seller to Buyer in accordance with the INCOTERMS set forth on face hereof. Title to and the right to possess the Goods shall pass from the Seller to the Buyer at the same time when the risk of loss or damage to the Goods is passed to the Buyer as stipulated above, however, that the title to and the right to possess the Goods are to be retained by Seller until Seller has received the full contract amount due to Seller pursuant to this Contract.

5. Payment. Payment by Buyer to Seller under this Contract shall be made by means of telegraphic transfer in immediately available funds to such bank account as designated by Seller or a confirmed, irrevocable, without recourse documentary letter of credit, in favor of Seller and with terms any satisfactory to Seller. If Buyer desires to pay Seller by means of a letter of credit, the letter of credit shall (i) cover the full contract amount (ii) be established through a prime-bank immediately after the date of this Contract, (iii) be negotiable on sight draft, and (iv) be valid for negotiation against the relative draft for at least fifteen (15) days after the end of the last month in which the Goods are shipped.

The letter of credit shall authorize reimbursement to Seller for any expenses incurred by Seller on account of Buyer pursuant hereto, and shall authorize partial payment against partial delivery. Any bank charges arising in connection with payment hereunder shall be borne by Buyer. If Buyer fails to satisfy any payment terms of this Contract, Seller at its sole discretion and at Buyer's expense and risk may resell all or any part of the Goods on account of Buyer, hold all or any part of the Goods on account of Buyer, cancel all or any part of this Contract and/or claim any damages resulting from such breach.

In the event of late payment of any amount due hereunder, Seller shall, in addition to any other remedy it may have hereunder or pursuant to applicable law, be entitled to receive interest at the maximum rate allowed by law in the country/state of Buyer or eighteen percent (18%) per annum, whichever is greater, on such late payment until payment is received in full.

6. Increased Costs. Any new, additional or increased freight rates, surcharges (bunker, currency, congestion or other surcharges), taxes, customs duties, export or import surcharges or other governmental charges, or insurance premiums, which may be incurred by Seller with respect to the Goods after the date of this Contract, shall be for the account of Buyer and shall be reimbursed to Seller by Buyer within a reasonable time on demand.

7. Force Majeure. Seller shall not be liable for failure or delay to perform its obligations hereunder due to any reason including, but not limited to, acts of God, earthquake, fire, flood, prohibition of exportation, refusal to issue export license, war, blockade, revolution, insurrection, civil commotion, riots, mobilization, strikes, lockout, plague, other epidemics, pandemics, or any other causes beyond the control of Seller, and may, at its option, extend the time of shipment or delivery of the Goods or terminate unconditionally and without liability of this Contract to the extent so affected or prevented.

8. Cancellation. If Buyer fails to carry out any of the terms of this and/or any other contract with Seller, or in the event of the death, bankruptcy or insolvency of Buyer, liquidation, modification or reorganization of the corporate structure of Buyer, or nonpayment for any shipment, Seller shall have the right to cancel this and/or any other contract with Buyer or to postpone the shipment, or to stop the Goods in transit, and Buyer shall indemnify, defend and hold Seller harmless from all losses, costs, and expenses resulting from Seller taking any such actions.

9. Intellectual Property Rights. Buyer shall defend, indemnify and hold Seller harmless from any and all liability, loss or expense (including reasonable attorneys fees) arising from or in connection with any actual or alleged infringement of any patent, trademark, copyright, industrial design, registered pattern, trade secret or other similar intellectual property rights used or owned by Seller.

10. Liability of Agent. If this Contract is signed by an agent or on behalf of a principal as Buyer hereunder, whether the principal is disclosed or otherwise, the agent shall be liable not only as agent but also as principal for the performance of the obligations of Buyer under this Contract. This provision shall not affect Buyer's obligation as principal under this Contract.

11. Construction. The meanings of the terms UCPDC or INCOTERMS, when used in this Contract shall be determined in accordance with the Uniform Customs and Practice for Documentary Credit ("UCPDC") and Incoterms® ("INCOTERMS") adopted by the International Chamber of Commerce in effect on the date of this Contract. This Contract shall be governed by the laws of the state of Washington, USA without giving effect to any conflicts of laws principles. This Contract shall not be governed by the United Nations Contracts for the International Sales of Goods, the application of which is expressly excluded.

12. Inspection. Unless otherwise stated on the face of this Contract, any export inspections by Japanese authorities, Seller's suppliers or Seller shall be considered as final. When Buyer requires special inspection by an independently appointed inspector, Buyer shall inform Seller in writing the details of such special inspection including without limitation the name of such inspector at the time of this Contract. Such especial inspection shall be made promptly upon delivery of the Goods but in any event within two (2) weeks after delivery of the Goods, and all inspection fees and costs therefor shall be borne by Buyer.

13. Warranty. Seller warrants that any Goods delivered hereunder are free from defects in material and workmanship and, if Seller's specifications are set forth or incorporated by reference on the face hereof, or separately provided to Buyer, will meet such Seller's specifications.

Unless otherwise specified in Seller's warranty statement set forth or incorporated by reference on the face hereof, or separately provided to Buyer, Seller's liability under this warranty is limited to repair or replacement of any Goods delivered hereunder that do not conform to this warranty.

Buyer shall not be entitled to any remedy for lack of conformity of the Goods, including latent defects, under this warranty if he fails to notify Seller thereof within a six months period commencing on the shipment date of the Goods (and if there are more than one shipment dates, the first shipment date). Such notification shall contain full particulars of such lack of conformity of the Goods to the Seller's reasonable satisfaction.

Notwithstanding anything herein contained to the contrary, Seller shall have no liability under this warranty i) for minor deviations from Seller's specifications (if applicable) that do not affect the performance of the Goods, or ii) for any lack of conformity of the Goods caused by misuse, neglect, improper installation, handling, operation, or maintenance, repair, alteration, fair wear and tear, erosion or corrosion, or accident, including any damage or loss of the whole or a part of the Goods that occurs after the shipment date.

14. Limitation of Liability. EXCEPT AS EXPRESSLY STATED IN SECTION 13, SELLER HEREBY DISCLAIMS ALL REPRESENTATIONS AND WARRANTIES WITH RESPECT TO THE GOODS, WHETHER EXPRESS, IMPLIED OR STATUTORY (EXCEPT AS TO TITLE) INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT AND OTHER IMPLIED WARRANTIES UNDER ANY APPLICABLE LAWS, RULES OR REGULATIONS. SECTION 13 SETS FORTH THE FULL EXTENT OF SELLER'S LIABILITY TO BUYER OR ANY OTHER PARTY FOR ANY BREACH OF WARRANTY WITH RESPECT TO THE GOODS.

NOTHWITHSTANDING ANY OTHER PROVISION OF THIS CONTRACT, SELLER'S AGGREGATE AND CUMULATIVE LIABILITY ARISING OUT OF OR RELATING TO THIS CONTRACT, INCLUDING WITHOUT LIMITATION ON ACCOUNT OF PERFORMANCE OR NON-PERFORMANCE OF OBLIGATIONS, REGARDLESS OF THE FORM OF THE CAUSE OF ACTION, WHETHER IN CONTRACT, TORT (INCLUDING WITHOUT LIMITATION NEGLIGENCE), STATUTORY OR OTHERWISE WILL BE LIMITED TO DIRECT DAMAGES AND SHALL NOT EXCEED THE FULL CONTRACT AMOUNT OF GOODS STATED ON THE FACE HEREOF.

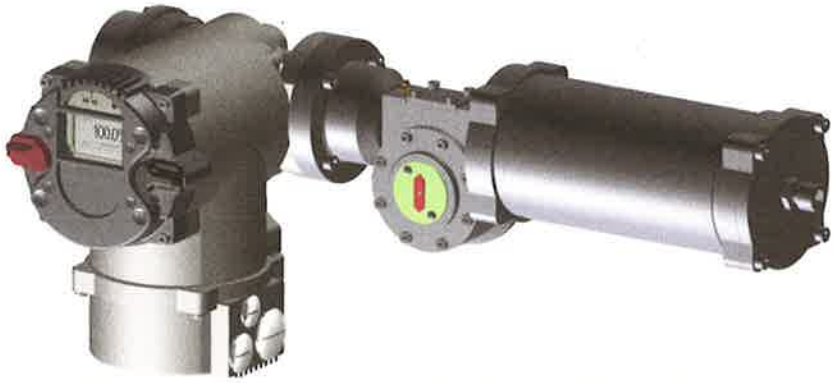
SELLER SHALL HAVE NO LIABILITY FOR ANY SPECIAL, INCIDENTAL, CONSEQUENTIAL OR SIMILAR DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE SALE, DELIVERY, NONDELIVERY, STORAGE, USE, MAINTENANCE, CONDITION OR POSSESSION OF THE GOODS

15. Arbitration. All disputes or controversies which may arise between the parties hereto, out of or in relation to or in connection with this Contract, shall be negotiated in good faith and settled by agreement between both parties as promptly as possible. If not amicably settled within 14 days after the first negotiation day, such disputes or controversies shall be settled by arbitration in Seattle, Washington by arbitration administered by the American Arbitration Association in accordance with its Commercial Arbitration Rules including the Optional Rules for Emergency Measures of Protection, and judgment on the award rendered by the arbitrators shall be final and binding and may be entered in any court having jurisdiction thereof**.** All arbitration proceedings shall be held in the English language.

16. Governing Law. These Terms and Conditions shall be governed by and construed in accordance with the laws of the State of Washington, USA, for both domestic and international sales contract. All buyers agree that jurisdiction and venue shall be Seattle, Washington State.

Product Data Sheet
Part Number DS – 87376-4, Rev. 1
Release: September 2016

EIM RTS FQ Fail-Safe Quarter-Turn Actuator



Smart and Compact

FAIL-SAFE QUARTER-TURN ACTUATOR

- Reliably drive valve in fail-safe position with a mechanical spring unit
- Control: integrated controls with frequency inverter and brushless DC motor
- Direct coupling of the fail-safe with the valve shaft
- Fail-safe triggering selectable in case of drop-off 24 V DC fail-safe signal or main power supply
- Fail-safe speed adjustable
- Modulating operation up to 1200 starts/ hour possible (S9 operation)
- Configurable fail-safe operating time and ramp speed
- Exclusive spring based mechanical energy storage – no hydraulics or battery required
- No need of periodical inspections – self-testing with every stroke
- Partial stroke test
- Low maintenance
- Integrated SMARTCON controls with wireless Bluetooth capability for configuration, monitoring, and diagnostics of key parameters
- Data Logger for diagnostics
- SMARTCON Android application
- Multi-lingual user-interface

Technical Details

- Switch off thrust electric: max. 2,000 Nm (1,475 lbs. ft)
- Modulating torque: max. 1,000 Nm (730 lbs. ft)
- Fail-safe torque: max. 1,000 Nm (730 lbs. ft)
- Adjustable positioning time (Electric): 15 - 650 sec
- Adjustable fail-safe operating time: 1–5 sec
- Non-intrusive limit setting
- Available for power supply:
  - 24 VDC
  - 1x115V – 230VAC, 50/60 Hz
  - 3x 380 – 480 VAC, 50/60 Hz
- Housing Material: Aluminum
- Standard NEMA 4 enclosure
- Certifcation: ATEX, CSA, UL, IECEx

Optional Features

- Analog position feedback 0/4-20mA (2-wire)
- Relay board for 250 VAC, 2A with 4 or 6 outputs
- Networking (Modbus RTU, HART)
- Mechanical manual override
- PID controller

EIM

EMERSON

TYPE		FQ-03	FQ-06	FQ-20
Max Electric Torque	max. lbs. ft (Nm)	220 (300)	440 (600)	1,475 (2,000)
Max Fail-safe Torque	max. lbs. ft (Nm)	110 (150)	220 (300)	730 (1,000)
Modulating Torque	max. lbs. ft (Nm)	110 (150)	220 (300)	730 (1,000)
Fail-safe Function		Selectable opening and closing (CW/CCW)		
Fail-safe Trigger		Loss of 24 V DC Fail-safe signal or main power supply (selectable)		
Positioning Speed - Electric	sec	14 to 420	14 to 420	30 to 850
Positioning Speed - Fail-safe	sec	1 - 5	1 - 5	3 - 10
Available Travel	°	90 +/– 5° with mechanical end-stop		
Mode of Operation	On/off Duty	S2–15 min		
	Modulating Duty	S4 – 1200 starts/hour – 40% duty cycle		
Manual Override		Optional		
VALVE-MOUNTING				
Flange	ISO 5210	F07/F10	F10/F12	F14/F16
Max Stem Diameter	in (mm)	1 (25.4)	1.38 (35)	2.17 (55)
Max Square (Flats)	in (mm)	0.86 (22)	1.25 (32)	1.87 (46)
ENVIRONMENTAL CONDITIONS				
Weather Protection		IP 67 /NEMA 4		
Ambient Temperature		- 40° C (-40°F) to +60°C (140°F)		
Corrosion Protection		K2 for aggressive atmospheres		
Painting/Color		Two component painting / RAL 7024		
Weight approx.	lb. (kg)	94 (43)	116 (53)	440 (200)
MOTOR - BRUSHLESS TECHNOLOGY				
Isolation Class		Insulation class F, max. 155° C (311°F) permanent temperature		
Power Supply	V	24 VDC or 115-230 VDC or 1x 115-230 VAC, 50-60Hz or 3x 380-480 VAc, 50-60 Hz		
	Nominal Current	2.5 A		
Power Comsumption Idle with Fail-safe Brake		40 W		
ACTUATOR CONTROL				
Technology	Integrated processor control unit with frequency technology for variable speed control			
Control Elements	· With additional language independent symbols · Selector switch LOCAL - OFF - REMOTE (lockable) · Control switch OPEN - STOP - CLOSE contact less sensor technology			
Local Display	Backlit LCD display, can be rotated in 90 degree steps			
LEDs	4 programmable red, green, blue LEDs for operation - readiness - warning - and error messages			
Communication	Infrared communication interface and bluetooth technology including ANDROID App for simple configuration			
Inputs	· 5 configurable binary (discrete inputs) control inputs: OPEN - STOP - CLOSE - EMERGENCY OPEN - EMERGENCY CLOSE · Nominal voltage 24VDC			
Outputs	· 8 configurable binary (relay) outputs: READY - OPEN - CLOSE - RUNNING OPEN - RUNNING CLOSE - TORQUE - LOCAL - REMOTE · Power supply 24 VDC +/– 6V (selectable internal or external)			
FUNCTIONS				
Standard	· Switch-off mode adjustable, travel or torque dependent · Torque adjustable: 25-100% of max. torque · Adjustable speed for process optimization and emergency speeds · Password protection (reading and/or writing) · Multi-language display · Status indication for binary inputs/outputs and analog signals on LCD Display · Data logging for analysis and service · Motor protection by Positive Temperature Coefficient sensors			
ELECTRICAL CONNECTION				
Cable Entry	3 metric threaded boreholes for cable grands: M40x1.5 / M32x1.5 / M25x1.5 (Optional: 2x NPT1/2" + 1xNPT1")			

[2] Unloading of SMU

The Membrane Unit is shipped as separate packages of an Upper Membrane Case, a Lower Membrane Case, and a Diffuser Case. The packaging style and lifting method of the Membrane Case and Diffuser Case is described below:

(1) Membrane Case

A Membrane Case is wrapped with plastic film around required areas and fixed on a wooden pallet. To unload the Membrane Case, use a forklift or a crane/hoist as below:

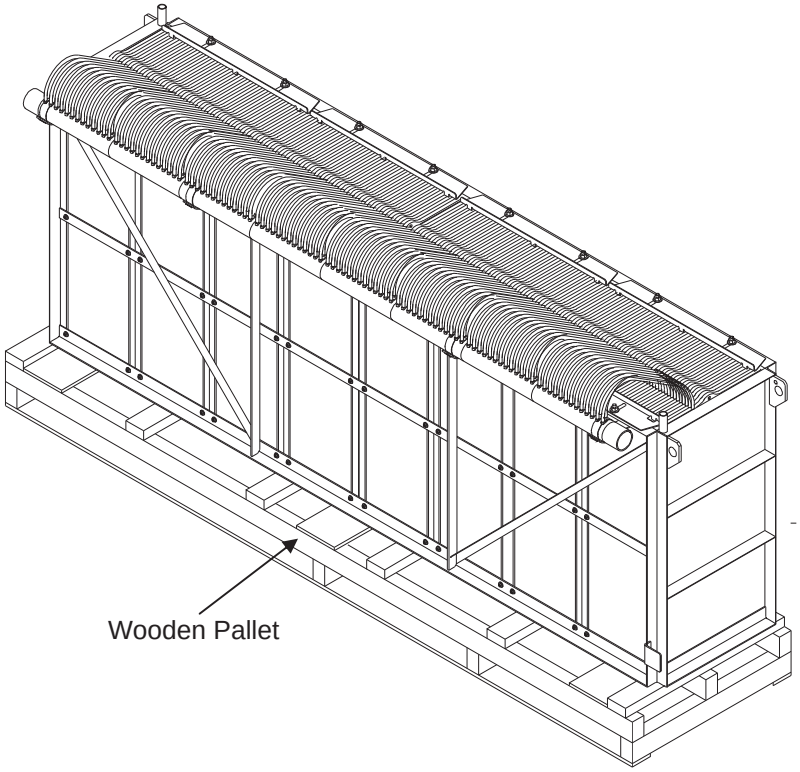


Fig. 2-1 Shipping Appearance of Upper Membrane Case of EK400

(a) Unloading with a Forklift

Insert its forks into the wooden pallet. Be careful not to damage the Membrane Cartridges with the arms of the forklift.

(b) Unloading with a Crane/Hoist

Always use the specialized Lifting Tool (optional part). Never fail to check the To know how to use the Lifting Tool, refer to “Optional Parts Instruction Manual for

KUBOTA Submerged Membrane Unit™—Lifting Tool—(EK/ES/FS)".

(2) Diffuser Case

When unloading a Diffuser Case from a truck, use the specialized Lifting Tool (optional part) or sling belts. In either case, to know how to lift up a Diffuser Case, refer to "Optional Parts Instruction Manual for KUBOTA Submerged Membrane Unit™—Lifting Tool—(EK/ES/FS)".

Danger **Before using parts that hold loads, such as Lifting Tool, check them for abnormalities such as cracks, corrosion, rust, abrasion, and deformation. Continued use of a damaged product may cause a fatal drop accident.**

Danger **Always lift up an Upper Membrane Case, a Lower Membrane Case, or a Diffuser Case individually one at a time. Lifting up two Cases at a time may damage Lifting Tool (optional parts), Lifting Chain (Customer's provision), and/or products, and may cause a fatal accident and/or equipment damage.**

Danger **Never go around or below the lifted Membrane Case or Diffuser Case. If they fall, severe accident may occur.**

Caution **Wear adequate gloves such as cotton work gloves during work. Working with bare hands may result in unexpected injuries.**

Prohibited **Lifting Tool is designed only for lifting up a Membrane Case or a Diffuser Case safely. Do not use the Lifting Tool for lifting up other products than the Membrane Case or Diffuser Case nor for other purposes.**

Prohibited **Do not remove the plastic wrapping film of the Upper Membrane Case before filling water. Do not remove the film of the Lower Membrane Case before installing the Upper Membrane Case. It prevents Membrane Cartridges from getting wet and dusty.**

Important **When lifting a Membrane Case with a forklift, be sure to insert its arms under the frame of the pallet and prevent the arms from hitting and breaking the Membrane Cartridges in the Membrane Case.**

Important **When lifting the Membrane Case, always use the specified Lifting Tool (Optional Parts). It serves to lift a Membrane Case safely without excess load.**

Important **Take care not to damage the Manifold, the Nozzles, or the Diffuser during the installation of SMU. When they are damaged, they cannot be utilized and should be replaced.**

[3] Things to Be Checked When SMU Arrives

When a package of the SMU arrives, it is recommended to check the followings:

(1) Confirm that the package contains all the components and parts indicated in the packing list.

(2) Make sure all the components and parts are not damaged during the shipment.

[4] Storage of SMU

Note the following points at storage of SMUs:

(1) Kubota SMU should be stored on a level surface.

(2) Keep the SMU covered with the plastic wrapping film to avoid exposure to water.

(3) Avoid exposure to direct sunlight, and store SMU indoors at the room temperature between 5 and 40ºC.

(4) Avoid high humidity or dusts during storage.

(5) Spare Membrane Cartridges for replacement should also be stored indoors. For detailed information, refer to “5.[4] Replacement Parts”.

Prohibited **Keep SMU and Membrane Cartridges away from heat or flame. They may cause damage on parts of SMU.**

Prohibited **Never expose Membrane Cases to welder or grinder sparks during construction work from delivery to commissioning work. Membrane Cartridges may get holes and get ruined, especially when they are exposed to sparks.**

Prohibited **Never leave out SMU for long time where it is exposed to direct sunlight or high temperature. This condition changes the shape or quality of SMU parts and it disables proper operation.**

Prohibited **Do not remove the plastic wrapping film from the Upper Membrane Case until operation starts. Do not remove the plastic wrapping film from the Lower Membrane Case until just before installing the Upper Membrane Case on it. It prevents Membrane Cartridges from getting wet and dusty.**

Important **Do not wet the Membrane Cartridges before use. When wet Membrane Cartridges dry, their filtration performance decreases significantly.**

Important **Take care not to damage the Manifold, the Nozzles, or the Diffuser during the installation of SMU. Otherwise it may result in Suspended Solids contamination in the permeate water. Damaged membranes cannot be repaired and used.**

[5] Installation of SMU

In the installation of a Membrane Unit, a Diffuser Case is installed first, next a Lower Membrane Case, and then an Upper Membrane Case is installed. Check the layout of SMUs with an equipment layout drawing for the facility, and install them within the deviations described in the following sections.

Detailed information about the installation of SMU is described in “Installation Procedure Manual for KUBOTA Submerged Membrane Unit™”. (It is included in “Optional Parts Instruction Manual for KUBOTA Submerged Membrane Unit™ — Lifting Tool — (EKESFS)”.)

(1) Installation of Diffuser Case (Fig. 2-2)

(a) Levelness

Install the Diffuser Case within the levelness below:

Levelness in the top face of a Diffuser Case : within 5 mm

Levelness among multiple Diffuser Cases : within 10 mm

(b) Anchorage

Fix the Diffuser Case with chemical anchors of the specifications like the followings (for reference):

Bolt size : M16 x 230

Hole size : ϕ19 x 130

(c) Guide Pipe

Never fail to install the Guide Pipes. For the installation method, refer to “(3) Installation of Guide Pipes”.

(2) Installation of Membrane Case

(a) Iinstallation of Lower Membrane Case

After installing the Guide Pipes, install the Lower Membrane Case as the following procedure:

Lift down the Lower Membrane Case along the Guide Pipes onto the Diffuser Case. Then position the Lower Membrane Case so that the four bolt holes in its bottom angles precisely match those of the Diffuser Case.

(b) Installation of Upper Membrane Case

After installing the Lower Membrane Case, install the Upper Membrane Case as the following procedure:

Lift down the Upper Membrane Case along the Guide Pipes onto the Lower Membrane Case. Then position the Upper Membarne Case so that the four bolt holes in its bottom angles precisely match those of the Lower Membrane Case.

(c) Installation of Lifting Chains and Stabilizer pipes

After installing the Lower and Upper Membrane Cases, install the Lifting Chains and the Stabilizer Pipes. (see Fig. 2-2)

* Remove the pallet from under the Membrane Case.

* Do not remove the plastic film covering the Upper Membrane Case before filiing water.

* Do not remove the palstic film covering the Lower Membrane Case before installing the Upper Membarne Case.

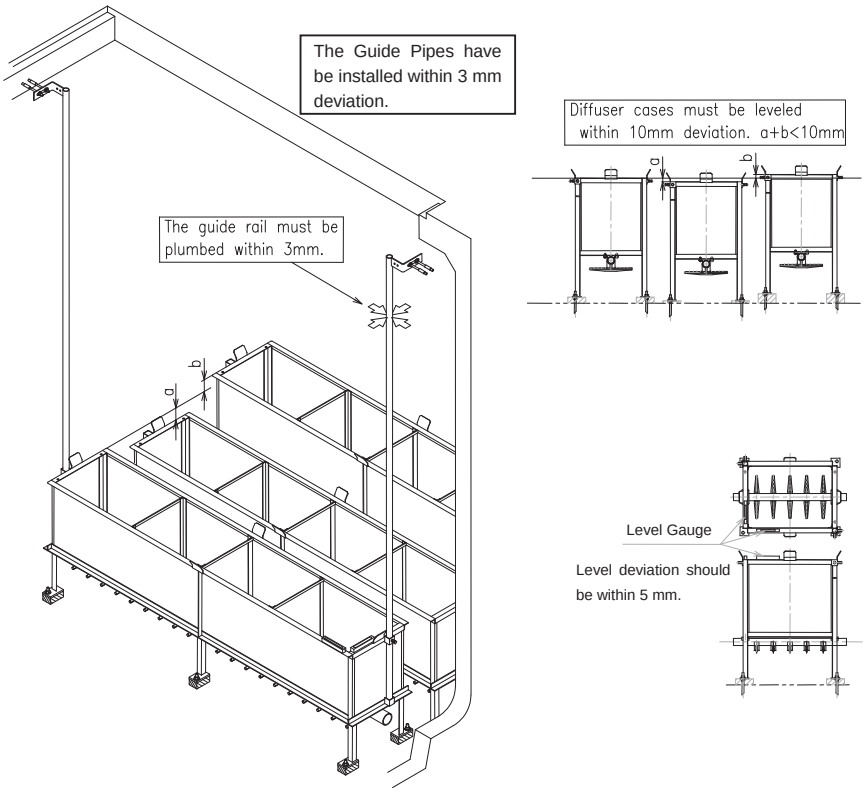


Fig. 2-2 Installation Deviation for Diffuser Case and Guide Pipe

(3) Installation of Guide Set (Optional Parts) (Fig. 2-3)

* A Guide Set is composed of Guide Pipes and Stabilizer Pipes.
* A cutting machine or tool is needed to adjust their length on site.
* If the dimensions of the tank opening are larger than KUBOTA's standard ones, supports to fix the Guide Pipes to the top part of the tank are needed. The supports are to be provided by Customer in accordance with the tank dimensions (Refer to "Assembly Drwaing for Membrane Unit" for the tank dimensions of KUBOTA's standard).

Check the detailed information about the installation of the Guide Set, referring to "Optional Parts Instruction Manual for KUBOTA Submerged Membrane Unit™—Guide Set—".

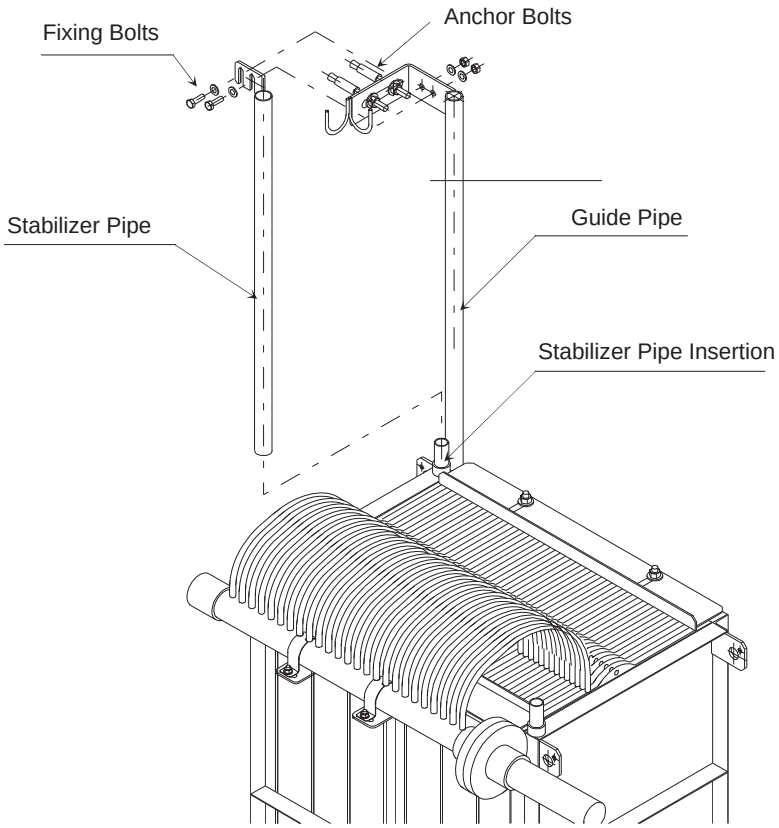


Fig. 2-3 Installation of Stabilizer Pipe

Appendix D

I/O Lists

LCP-1000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
LCP-1000	*Horn Silence*	*10018*	*DI*	*1*	*1*	*1*	*0*
LCP-1000	*Alarm Acknowledge*	*10020*	*DI*	*1*	*1*	*1*	*1*
LCP-1000	*Alarm Reset*	*10022*	*DI*	*1*	*1*	*1*	*2*
LCP-1000	*Lamp Test*	*10024*	*DI*	*1*	*1*	*1*	*3*
ME-1600	Screen Running	11000	DI	1	1	1	4
ME-1600	Screen Faulted	11002	DI	1	1	1	5
ME-1600	Screen Stopped	11004	DI	1	1	1	6
ME-1600	Screen High Level Alarm	11006	DI	1	1	1	7
M-1603	*Seal Leak*	*1603-2*	*DI*	*1*	*1*	*1*	*8*
M-1603	*Motor Overtemp*	*1603-1*	*DI*	*1*	*1*	*1*	*9*
M-1703	*Seal Leak*	*1703-2*	*DI*	*1*	*1*	*1*	*10*
M-1703	*Motor Overtemp*	*1703-1*	*DI*	*1*	*1*	*1*	*11*
M-1803	*Seal Failure*	*1803-2*	*DI*	*1*	*1*	*1*	*12*
M-1803	*Motor Overtemp*	*1803-1*	*DI*	*1*	*1*	*1*	*13*
	Spare	*11106*	*DI*	*1*	*1*	*1*	*14*
	Spare	*11108*	*DI*	*1*	*1*	*1*	*15*
ME-1200	*Control Power Available*	*11114*	*DI*	*1*	*1*	*2*	*0*
ME-1200	*Motor Running*	*11116*	*DI*	*1*	*1*	*2*	*1*
ME-1200	*Overload Trip*	*11118*	*DI*	*1*	*1*	*2*	*2*
ME-1200	*MCC in Hand*	*11120*	*DI*	*1*	*1*	*2*	*3*
ME-1200	*MCC in Auto*	*11122*	*DI*	*1*	*1*	*2*	*4*
ME-1200	*Field - Jog*	*11124*	*DI*	*1*	*1*	*2*	*5*
ME-1200	*Field in Remote*	*11126*	*DI*	*1*	*1*	*2*	*6*
ME-1200	*Motor Overcurrent*	*11128*	*DI*	*1*	*1*	*2*	*7*
ME-1200	*Motor Overtorque*	*11158*	*DI*	*1*	*1*	*2*	*8*
ME-1200	*Door Interlock*	*11148*	*DI*	*1*	*1*	*2*	*9*
LCP-1206	*Spray System in Hand*	*11134*	*DI*	*1*	*1*	*2*	*10*
LCP-1206	*Spray System in Auto*	*11136*	*DI*	*1*	*1*	*2*	*11*
LCP-1206	*Emergency Stop*	*11138*	*DI*	*1*	*1*	*2*	*12*
	DO NOT USE	11140	DI	1	1	2	13
	DO NOT USE	11142	DI	1	1	2	14
	DO NOT USE	11146	DI	1	1	2	15
ME-1400	*Control Power Available*	*11614*	*DI*	*1*	*1*	*3*	*0*
ME-1400	*Motor Running*	*11616*	*DI*	*1*	*1*	*3*	*1*
ME-1400	*Overload Trip*	*11618*	*DI*	*1*	*1*	*3*	*2*
ME-1400	*MCC in Hand*	*11620*	*DI*	*1*	*1*	*3*	*3*
ME-1400	*MCC in Auto*	*11622*	*DI*	*1*	*1*	*3*	*4*
ME-1400	*Field - Jog*	*11624*	*DI*	*1*	*1*	*3*	*5*
ME-1400	*Field in Remote*	*11626*	*DI*	*1*	*1*	*3*	*6*
ME-1400	*Motor Overcurrent*	*11628*	*DI*	*1*	*1*	*3*	*7*
ME-1400	*Motor Overtorque*	*11658*	*DI*	*1*	*1*	*3*	*8*
ME-1400	*Door Interlock*	*11646*	*DI*	*1*	*1*	*3*	*9*
LCP-1406	*Spray System in Hand*	*11634*	*DI*	*1*	*1*	*3*	*10*
LCP-1406	*Spray System in Auto*	*11636*	*DI*	*1*	*1*	*3*	*11*
LCP-1406	*Emergency Stop*	*11638*	*DI*	*1*	*1*	*3*	*12*

LCP-1000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
	DO NOT USE	11640	DI	1	1	3	13
	DO NOT USE	11642	DI	1	1	3	14
	DO NOT USE	11646	DI	1	1	3	15
Grit Classifier	*LEL-1505*	*11200*	*DI*	*1*	*1*	*4*	*0*
Odor Control	*LEL-1512*	*11202*	*DI*	*1*	*1*	*4*	*1*
Drain Sump	*LSHH-1522*	*15032*	*DI*	*1*	*1*	*4*	*2*
Drain Sump	*LSH-1522*	*15034*	*DI*	*1*	*1*	*4*	*3*
Drain Sump	*LSL-1522*	*15036*	*DI*	*1*	*1*	*4*	*4*
Drain Sump	*LSLL-1522*	*15038*	*DI*	*1*	*1*	*4*	*5*
P-1503	*Seal Leak*	*1503-2*	*DI*	*1*	*1*	*4*	*6*
P-1503	*Motor Overtemp*	*1503-1*	*DI*	*1*	*1*	*4*	*7*
P-1504	*Seal Leak*	*1504-2*	*DI*	*1*	*1*	*4*	*8*
P-1504	*Motor Overtemp*	*1504-1*	*DI*	*1*	*1*	*4*	*9*
	Spare	11278	DI	1	1	4	10
LCP-1606	Spray System in Auto	11280	DI	1	1	4	11
LCP-1606	Emergency Stop	15018	DI	1	1	4	12
Fine Screen No.1	*LSHH-1203*	*15016*	*DI*	*1*	*1*	*4*	*13*
Fine Screen No.2	*LSHH-1403*	*15020*	*DI*	*1*	*1*	*4*	*14*
ISR	*Spare*	*15022*	*DI*	*1*	*1*	*4*	*15*
ME-1502	*Control Power Available*	*11314*	*DI*	*1*	*1*	*5*	*0*
ME-1502	*Motor Running*	*11316*	*DI*	*1*	*1*	*5*	*1*
ME-1502	*Overload Trip*	*11318*	*DI*	*1*	*1*	*5*	*2*
ME-1502	*MCC in Hand*	*11320*	*DI*	*1*	*1*	*5*	*3*
ME-1502	*MCC in Auto*	*11322*	*DI*	*1*	*1*	*5*	*4*
ME-1502	*Field Jog*	*11324*	*DI*	*1*	*1*	*5*	*5*
ME-1502	*Field in Remote*	*11326*	*DI*	*1*	*1*	*5*	*6*
	Spare	*11328*	*DI*	*1*	*1*	*5*	*7*
V-1111	*Control Power Available*	*11-1*	*DI*	*1*	*1*	*6*	*0*
V-1111	*Open Valve*	*11344*	*DI*	*1*	*1*	*6*	*1*
V-1111	*Close Valve*	*11346*	*DI*	*1*	*1*	*6*	*2*
V-1111	*Ready*	*11482*	*DI*	*1*	*1*	*6*	*3*
V-1111	*Valve Open*	*11348*	*DI*	*1*	*1*	*6*	*4*
V-1111	*Valve Closed*	*11350*	*DI*	*1*	*1*	*6*	*5*
	Spare	*11352*	*DI*	*1*	*1*	*6*	*6*
	Spare	*11354*	*DI*	*1*	*1*	*6*	*7*
V-1311	*Control Power Available*	*11-6*	*DI*	*1*	*1*	*7*	*0*
V-1311	*Open Valve*	*11360*	*DI*	*1*	*1*	*7*	*1*
V-1311	*Close Valve*	*11362*	*DI*	*1*	*1*	*7*	*2*
V-1311	*Ready*	*11472*	*DI*	*1*	*1*	*7*	*3*
V-1311	*Valve Open*	*11364*	*DI*	*1*	*1*	*7*	*4*
V-1311	*Valve Closed*	*11366*	*DI*	*1*	*1*	*7*	*5*
	Spare	*11368*	*DI*	*1*	*1*	*7*	*6*
	Spare	*11370*	*DI*	*1*	*1*	*7*	*7*
P-1503	*Control Power Available*	*11204*	*DI*	*1*	*1*	*8*	*0*

LCP-1000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
P-1503	Motor Running	11206	DI	1	1	8	1
P-1503	Overload Trip	11208	DI	1	1	8	2
P-1503	MCC in Hand	11210	DI	1	1	8	3
P-1503	MCC in Auto	11212	DI	1	1	8	4
P-1503	Field - Jog	11214	DI	1	1	8	5
P-1503	Field in Remote	11216	DI	1	1	8	6
	Spare	11218	DI	1	1	8	7
P-1504	Control Power Available	11246	DI	1	1	9	0
P-1504	Motor Running	11248	DI	1	1	9	1
P-1504	Overload Trip	11250	DI	1	1	9	2
P-1504	MCC in Hand	11252	DI	1	1	9	3
P-1504	MCC in Auto	11254	DI	1	1	9	4
P-1504	Field - Jog	11256	DI	1	1	9	5
P-1504	Field in Remote	11258	DI	1	1	9	6
	Spare	11260	DI	1	1	9	7
ME-1511	Control Power Available	11284	DI	1	1	10	0
ME-1511	Motor Running	11286	DI	1	1	10	1
ME-1511	Overload Trip	11288	DI	1	1	10	2
ME-1511	MCC in Hand	11290	DI	1	1	10	3
ME-1511	MCC in Auto	11292	DI	1	1	10	4
ME-1511	Field - Jog	11294	DI	1	1	10	5
ME-1511	Field in Remote	11296	DI	1	1	10	6
	Spare	11298	DI	1	1	10	7
V-1602	Control Power Available	11376	DI	1	1	11	0
V-1602	Field Stop	21317	DI	1	1	11	1
V-1602	Remote Status	11378	DI	1	1	11	2
V-1602	Valve Open	11380	DI	1	1	11	3
V-1602	Valve Closed	11382	DI	1	1	11	4
V-1602	High Torque Closing	11384	DI	1	1	11	5
V-1602	High Torque Opening	11386	DI	1	1	11	6
	Spare	11388	DI	1	1	11	7
M-1603	Control Power Available	10026	DI	1	2	0	0
M-1603	Motor Running	10028	DI	1	2	0	1
M-1603	Overload Trip	10030	DI	1	2	0	2
M-1603	MCC in Hand	10032	DI	1	2	0	3
M-1603	MCC in Auto	10034	DI	1	2	0	4
M-1603	Field - Jog	10036	DI	1	2	0	5
M-1603	Field in Remote	10038	DI	1	2	0	6
	Spare	10040	DI	1	2	0	7
V-1702	Control Power Available	11408	DI	1	2	1	0
V-1702	Field Stop	21317	DI	1	2	1	1
V-1702	Remote Status	11410	DI	1	2	1	2
V-1702	Valve Open	11412	DI	1	2	1	3
V-1702	Valve Closed	11414	DI	1	2	1	4

LCP-1000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
V-1702	*High Torque Closing*	*11416*	*DI*	*1*	*2*	*1*	*5*
V-1702	*High Torque Opening*	*11418*	*DI*	*1*	*2*	*1*	*6*
	Spare	*11420*	*DI*	*1*	*2*	*1*	*7*
M-1703	*Control Power Available*	*11036*	*DI*	*1*	*2*	*2*	*0*
M-1703	*Motor Running*	*11038*	*DI*	*1*	*2*	*2*	*1*
M-1703	*Overload Trip*	*11040*	*DI*	*1*	*2*	*2*	*2*
M-1703	*MCC in Hand*	*11042*	*DI*	*1*	*2*	*2*	*3*
M-1703	*MCC in Auto*	*11044*	*DI*	*1*	*2*	*2*	*4*
M-1703	*Field - Jog*	*11046*	*DI*	*1*	*2*	*2*	*5*
M-1703	*Field in Remote*	*11048*	*DI*	*1*	*2*	*2*	*6*
	Spare	*11050*	*DI*	*1*	*2*	*2*	*7*
V-1802	Control Power Available	11440	DI	1	2	3	0
V-1802	Field Stop	21317	DI	1	2	3	1
V-1802	Remote Position	11442	DI	1	2	3	2
V-1802	Open Status	11444	DI	1	2	3	3
V-1802	Closed Status	11446	DI	1	2	3	4
V-1802	High Torque	11448	DI	1	2	3	5
	Spare	*11450*	*DI*	*1*	*2*	*3*	*6*
	Spare	*11452*	*DI*	*1*	*2*	*3*	*7*
M-1803	Control Power Available	11072	DI	1	2	4	0
M-1803	Motor Running	11074	DI	1	2	4	1
M-1803	Motor Not Faulted	11076	DI	1	2	4	2
M-1803	Hand Position	11078	DI	1	2	4	3
M-1803	Auto Position	11080	DI	1	2	4	4
M-1803	Local from Field	11082	DI	1	2	4	5
M-1803	Remote from Field	11084	DI	1	2	4	6
	Spare	*11086*	*DI*	*1*	*2*	*4*	*7*
V-1111	*Call Valve Open*	*11484*	*DO*	*1*	*2*	*5*	*0*
V-1111	*Call Valve Closed*	*11486*	*DO*	*1*	*2*	*5*	*1*
SV-1103	*Call Open*	*11488*	*DO*	*1*	*2*	*5*	*2*
ME-1600	Screen Run Command	11358	DO	1	2	5	3
V-1311	*Call Valve Open*	*11474*	*DO*	*1*	*2*	*5*	*4*
V-1311	*Call Valve Closed*	*11476*	*DO*	*1*	*2*	*5*	*5*
SV-1303	*Call Open*	*11478*	*DO*	*1*	*2*	*5*	*6*
	Spare	*11374*	*DO*	*1*	*2*	*5*	*7*
ME-1204	*Ready*	*11152*	*DO*	*1*	*2*	*6*	*0*
ME-1204	*Jog Call*	*11154*	*DO*	*1*	*2*	*6*	*1*
ME-1204	*Auto Call*	*11154*	*DO*	*1*	*2*	*6*	*2*
ME-1204	*Reset - PLC*	*11158*	*DO*	*1*	*2*	*6*	*3*
SV-1202	*Open*	*11160*	*DO*	*1*	*2*	*6*	*4*
	Spare	*11164*	*DO*	*1*	*2*	*6*	*5*
	Spare	*11168*	*DO*	*1*	*2*	*6*	*6*
	Spare	*11172*	*DO*	*1*	*2*	*6*	*7*
ME-1400	*Ready*	*11652*	*DO*	*1*	*2*	*7*	*0*

LCP-1000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
ME-1400	*Jog Call*	*11654*	*DO*	*1*	*2*	*7*	*1*
ME-1400	*Auto Call*	*11654*	*DO*	*1*	*2*	*7*	*2*
ME-1400	*Reset - PLC*	*11658*	*DO*	*1*	*2*	*7*	*3*
SV-1402	*Open*	*11660*	*DO*	*1*	*2*	*7*	*4*
	Spare	*11664*	*DO*	*1*	*2*	*7*	*5*
ME-1502	*Ready*	*11332*	*DO*	*1*	*2*	*7*	*6*
ME-1502	*Auto Call*	*11336*	*DO*	*1*	*2*	*7*	*7*
ME-1502	*Alarm*	*11338*	*DO*	*1*	*2*	*8*	*0*
	Spare	*11342*	*DO*	*1*	*2*	*8*	*1*
ME-1503	*Ready*	*11222*	*DO*	*1*	*2*	*8*	*2*
ME-1503	*Jog Call*	*11224*	*DO*	*1*	*2*	*8*	*3*
ME-1503	*Auto Call*	*11224*	*DO*	*1*	*2*	*8*	*4*
V-1802	*Valve Stop*	*11230*	*DO*	*1*	*2*	*8*	*5*
V-1802	*Valve Open*	*11234*	*DO*	*1*	*2*	*8*	*6*
V-1802	*Valve Close*	*11238*	*DO*	*1*	*2*	*8*	*7*
P-1504	*Ready*	*11264*	*DO*	*1*	*2*	*9*	*0*
P-1504	*Jog Call*	*11266*	*DO*	*1*	*2*	*9*	*1*
P-1504	*Auto Call*	*11266*	*DO*	*1*	*2*	*9*	*2*
	Spare	*11272*	*DO*	*1*	*2*	*9*	*3*
ME-1511	*Ready*	*11302*	*DO*	*1*	*2*	*9*	*4*
ME-1511	*Jog Call*	*11304*	*DO*	*1*	*2*	*9*	*5*
ME-1511	*Auto Call*	*11304*	*DO*	*1*	*2*	*9*	*6*
	Spare	*11310*	*DO*	*1*	*2*	*9*	*7*
V-1602	*Valve Stop*	*11392*	*DO*	*1*	*2*	*10*	*0*
V-1602	*Valve Open*	*11396*	*DO*	*1*	*2*	*10*	*1*
V-1602	*Valve Close*	*11398*	*DO*	*1*	*2*	*10*	*2*
	Spare	*11402*	*DO*	*1*	*2*	*10*	*3*
V-1702	*Valve Stop*	*10044*	*DO*	*1*	*2*	*10*	*4*
V-1702	*Valve Open*	*10046*	*DO*	*1*	*2*	*10*	*5*
V-1702	*Valve Close*	*10046*	*DO*	*1*	*2*	*10*	*6*
	Spare	*11026*	*DO*	*1*	*2*	*10*	*7*
M-1603	*Ready*	*11424*	*DO*	*1*	*2*	*11*	*0*
M-1603	*Jog Call*	*11428*	*DO*	*1*	*2*	*11*	*1*
M-1603	*Auto Call*	*11430*	*DO*	*1*	*2*	*11*	*2*
	Spare	*11434*	*DO*	*1*	*2*	*11*	*3*
M-1703	*Ready*	*11054*	*DO*	*1*	*2*	*11*	*4*
M-1703	*Jog Call*	*11056*	*DO*	*1*	*2*	*11*	*5*
M-1703	*Auto Call*	*11056*	*DO*	*1*	*2*	*11*	*6*
	Spare	*11062*	*DO*	*1*	*2*	*11*	*7*
M-1803	Ready	11090	DO	1	2	12	0
M-1803	Jog Call	11092	DO	1	2	12	1
M-1803	Auto Call	11100	DO	1	2	12	2
	Spare	*11466*	*DO*	*1*	*2*	*12*	*3*
	Spare		*DO*	*1*	*2*	*12*	*4*

LCP-1000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
Blank			*DO*	*1*	*2*	*12*	*5*
Blank			*DO*	*1*	*2*	*12*	*6*
Blank			*DO*	*1*	*2*	*12*	*7*
LCP-1000	*Alarm Horn*	*10002*	*DO*	*1*	*2*	*13*	*0*
LCP-1000	*CR Horn*	*10004A*	*DO*	*1*	*2*	*13*	*1*
Spare		*10006*	*DO*	*1*	*2*	*13*	*2*
Spare		*10008*	*DO*	*1*	*2*	*13*	*3*
Spare		*10010*	*DO*	*1*	*2*	*13*	*4*
Spare		*10012*	*DO*	*1*	*2*	*13*	*5*
Spare		*10014*	*DO*	*1*	*2*	*13*	*6*
Spare		*10016*	*DO*	*1*	*2*	*13*	*7*
LIT-1205	*Tank Level (0-2.25 ft.)*	*15024*	*AI*	*1*	*2*	*14*	*0*
LIT-1603	Level (0-XX ft.)	15028	AI	1	2	14	1
DOT-1605	*DO (0-7 mg/L)*	*13000*	*AI*	*1*	*2*	*14*	*2*
LIT-1604	*Level (0-10 ft.)*	*13032*	*AI*	*1*	*2*	*14*	*3*
DOT-1705	*DO (0-7 mg/L)*	*13004*	*AI*	*1*	*2*	*14*	*4*
LIT-1704	*Level (0-10 ft.)*	*13036*	*AI*	*1*	*2*	*14*	*5*
DOT-1805	DO (0-7 mg/L)	13008	AI	1	2	14	6
LIT-1804	*Level (0-10 ft.)*	*13040*	*AI*	*1*	*2*	*14*	*7*
Pre-MBR	*DO-1904*	*13012*	*AI*	*1*	*2*	*14*	*8*
Pre-MBR	*DO-1905*	*13016*	*AI*	*1*	*2*	*14*	*9*
Pre-MBR	*DO-1906*	*13020*	*AI*	*1*	*2*	*14*	*10*
Spare		*13044*	*AI*	*1*	*2*	*14*	*11*
Spare		*13024*	*AI*	*1*	*2*	*14*	*12*
Spare		*13028*	*AI*	*1*	*2*	*14*	*13*
Spare		*13048*	*AI*	*1*	*2*	*14*	*14*
Spare		*13052*	*AI*	*1*	*2*	*14*	*15*
Spare			AO	1	2	15	0
Spare			*AO*	*1*	*2*	*15*	*1*
Spare			*AO*	*1*	*2*	*15*	*2*
Spare			*AO*	*1*	*2*	*15*	*3*
Spare			*AO*	*1*	*2*	*15*	*4*
Spare			*AO*	*1*	*2*	*15*	*5*
Spare			*AO*	*1*	*2*	*15*	*6*
Spare			*AO*	*1*	*2*	*15*	*7*

LCP-2000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
SPARE		*21122*	*DO*	*1*	*1*	*1*	*0*
P-2225	JOG CALL	21124	DO	1	1	1	1
P-2225	AUTO CALL	21124	DO	1	1	1	2
SPARE			*DO*	*1*	*1*	*1*	*3*
P-2226	JOG CALL	21180	DO	1	1	1	4
P-2226	AUTO CALL	21180	DO	1	1	1	5
V-2312	*VALVE STOP*	*21332*	*DO*	*1*	*1*	*1*	*6*
V-2312	*VALVE OPEN*	*21336*	*DO*	*1*	*1*	*1*	*7*
V-2312	*VALVE CLOSE*	*21338*	*DO*	*1*	*1*	*1*	*8*
88TH PUMP STATION	*RUNNING*	*21800*	*DO*	*1*	*1*	*1*	*9*
SPARE			*DO*	*1*	*1*	*1*	*10*
SPARE			*DO*	*1*	*1*	*1*	*11*
REUSE PUMP	*RUNNING*	*21802*	*DO*	*1*	*1*	*1*	*12*
ENV PUMP	*RUNNING*	*21804*	*DO*	*1*	*1*	*1*	*13*
ALARM	*HORN*	*21806*	*DO*	*1*	*1*	*1*	*14*
ALARM	*CONTROL RELAY*	*21808A*	*DO*	*1*	*1*	*1*	*15*
SPARE			*DO*	*1*	*1*	*2*	*0*
SPARE			*DO*	*1*	*1*	*2*	*1*
SPARE			*DO*	*1*	*1*	*2*	*2*
SPARE			*DO*	*1*	*1*	*2*	*3*
SPARE			*DO*	*1*	*1*	*2*	*4*
SPARE			*DO*	*1*	*1*	*2*	*5*
SPARE			*DO*	*1*	*1*	*2*	*6*
SPARE			*DO*	*1*	*1*	*2*	*7*
SPARE			*DO*	*1*	*1*	*2*	*8*
SPARE			*DO*	*1*	*1*	*2*	*9*
SPARE			*DO*	*1*	*1*	*2*	*10*
SPARE			*DO*	*1*	*1*	*2*	*11*
SPARE			*DO*	*1*	*1*	*2*	*12*
SPARE			*DO*	*1*	*1*	*2*	*13*
SPARE			*DO*	*1*	*1*	*2*	*14*
SPARE			*DO*	*1*	*1*	*2*	*15*
FIT-2311	*FLOW (0-XX GPM)*	*23294*	*AI*	*1*	*1*	*3*	*0*
LT-2521	LEVEL		AI	1	1	3	1
SPARE			*AI*	*1*	*1*	*3*	*2*
SPARE			*AI*	*1*	*1*	*3*	*3*
SPARE			*AI*	*1*	*1*	*3*	*4*
SPARE			*AI*	*1*	*1*	*3*	*5*
SPARE			*AI*	*1*	*1*	*3*	*6*
SPARE			*AI*	*1*	*1*	*3*	*7*
SPARE			*AI*	*1*	*1*	*3*	*8*
SPARE			*AI*	*1*	*1*	*3*	*9*
SPARE			*AI*	*1*	*1*	*3*	*10*
SPARE			*AI*	*1*	*1*	*3*	*11*
SPARE			*AI*	*1*	*1*	*3*	*12*

LCP-2000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
SPARE			*AI*	*1*	*1*	*3*	*13*
SPARE			*AI*	*1*	*1*	*3*	*14*
SPARE			*AI*	*1*	*1*	*3*	*15*
SPARE			*AO*	*1*	*1*	*4*	*0*
SPARE			*AO*	*1*	*1*	*4*	*1*
SPARE			*AO*	*1*	*1*	*4*	*2*
SPARE			*AO*	*1*	*1*	*4*	*3*
SPARE			*AO*	*1*	*1*	*4*	*4*
SLUDGE LOUD OUT	*QUANTITY*	*24046 / 24048*	*AO*	*1*	*1*	*4*	*5*
SPARE			*AO*	*1*	*1*	*4*	*6*
SPARE			*AO*	*1*	*1*	*4*	*7*
P-2225	CONTROL POWER AVAILABLE	21100	DI	1	1	5	0
P-2225	MOTOR RUNNING	21102	DI	1	1	5	1
P-2225	MOTOR NOT FAULTED	21104	DI	1	1	5	2
P-2225	HAND POSITION	21106	DI	1	1	5	3
P-2225	AUTO POSITION	21108	DI	1	1	5	4
P-2225	LOCAL FROM FIELD	21110	DI	1	1	5	5
P-2225	REMOTE FROM FIELD	21112	DI	1	1	5	6
P-2225	SEAL FAILURE	21114	DI	1	1	5	7
P-2225	MOTOR OVERTEMP	21116	DI	1	1	5	8
P-2226	CONTROL POWER AVAILABLE	21144	DI	1	1	5	9
P-2226	MOTOR RUNNING	21146	DI	1	1	5	10
P-2226	MOTOR NOT FAULTED	21148	DI	1	1	5	11
P-2226	HAND POSITION	21150	DI	1	1	5	12
P-2226	AUTO POSITION	21152	DI	1	1	5	13
P-2226	LOCAL FROM FIELD	21154	DI	1	1	5	14
P-2226	REMOTE FROM FIELD	21156	DI	1	1	5	15
P-2226	SEAL FAILURE	21158	DI	1	1	6	0
P-2226	MOTOR OVERTEMP	21160	DI	1	1	6	1
LCP-2000	*HORN SILENCE*	*21826*	*DI*	*1*	*1*	*6*	*2*
LCP-2000	*ALARM ACKNOWLEDGE*	*21828*	*DI*	*1*	*1*	*6*	*3*
LCP-2000	*ALARM RESET*	*21830*	*DI*	*1*	*1*	*6*	*4*
LCP-2000	*LAMP TEST*	*21832*	*DI*	*1*	*1*	*6*	*5*
LCP-2325	*GALLONS WEST SLUDGE ROOM*	*21300*	*DI*	*1*	*1*	*6*	*6*
LCP-2325	*LOWER SETPOINT*	*21302*	*DI*	*1*	*1*	*6*	*7*
LCP-2325	*RAISE SETPOINT*	*21304*	*DI*	*1*	*1*	*6*	*8*
LCP-2325	*START TRANSFER*	*21306*	*DI*	*1*	*1*	*6*	*9*
LCP-2325	*STOP TRANSFER*	*21308*	*DI*	*1*	*1*	*6*	*10*
LCP-2325	*KEY LOCKOUT*	*21310*	*DI*	*1*	*1*	*6*	*11*
DRAIN SUMP	*LSLL-2227*	*21788*	*DI*	*1*	*1*	*6*	*12*
DRAIN SUMP	*LSL-2227*	*21790*	*DI*	*1*	*1*	*6*	*13*
DRAIN SUMP	*LSH-2227*	*21792*	*DI*	*1*	*1*	*6*	*14*
DRAIN SUMP	*LSHH-2227*	*21794*	*DI*	*1*	*1*	*6*	*15*
BACK-UP DRAIN SUMP	*LSLL-2228*	*21796*	*DI*	*1*	*1*	*7*	*0*

LCP-2000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
V-2312	*CONTROL POWER AVAILABLE*	*21316*	*DI*	*1*	*1*	*7*	*1*
V-2312	*FIELD STOP*	*21317*	*DI*	*1*	*1*	*7*	*2*
V-2312	*REMOTE STATUS*	*21318*	*DI*	*1*	*1*	*7*	*3*
V-2312	*VALVE OPEN*	*21320*	*DI*	*1*	*1*	*7*	*4*
V-2312	*VALVE CLOSED*	*21322*	*DI*	*1*	*1*	*7*	*5*
V-2312	*HIGH TORQUE CLOSING*	*21324*	*DI*	*1*	*1*	*7*	*6*
V-2312	*HIGH TORQUE OPENING*	*21326*	*DI*	*1*	*1*	*7*	*7*
P-2225	STOP		DI	1	1	7	8
P-2226	STOP		DI	1	1	7	9
LCP-2000	*POWER SUPPLY STATUS*		*DI*	*1*	*1*	*7*	*10*
	SPARE		*DI*	*1*	*1*	*7*	*11*
	SPARE		*DI*	*1*	*1*	*7*	*12*
	SPARE		*DI*	*1*	*1*	*7*	*13*
	SPARE		*DI*	*1*	*1*	*7*	*14*
	SPARE		*DI*	*1*	*1*	*7*	*15*
	SPARE		*DO*	*1*	*2*	*0*	*0*
ME-2125	AUTO CALL	22014	DO	1	2	0	1
	SPARE		*DO*	*1*	*2*	*0*	*2*
P-2150	AUTO CALL	22024	DO	1	2	0	3
ME-2325	*FAULT RESET*	*22066*	*DO*	*1*	*2*	*0*	*4*
ME-2325	*CALL*	*22068*	*DO*	*1*	*2*	*0*	*5*
	SPARE		*DO*	*1*	*2*	*0*	*6*
	SPARE		*DO*	*1*	*2*	*0*	*7*
	SPARE		*DO*	*1*	*2*	*0*	*8*
	SPARE		*DO*	*1*	*2*	*0*	*9*
	SPARE		*DO*	*1*	*2*	*0*	*10*
	SPARE		*DO*	*1*	*2*	*0*	*11*
	SPARE		*DO*	*1*	*2*	*0*	*12*
	SPARE		*DO*	*1*	*2*	*0*	*13*
	SPARE		*DO*	*1*	*2*	*0*	*14*
	SPARE		*DO*	*1*	*2*	*0*	*15*
	SPARE		*DO*	*1*	*2*	*1*	*0*
	SPARE		*DO*	*1*	*2*	*1*	*1*
	SPARE		*DO*	*1*	*2*	*1*	*2*
	SPARE		*DO*	*1*	*2*	*1*	*3*
	SPARE		*DO*	*1*	*2*	*1*	*4*
	SPARE		*DO*	*1*	*2*	*1*	*5*
	SPARE		*DO*	*1*	*2*	*1*	*6*
	SPARE		*DO*	*1*	*2*	*1*	*7*
	SPARE		*DO*	*1*	*2*	*1*	*8*
	SPARE		*DO*	*1*	*2*	*1*	*9*
	SPARE		*DO*	*1*	*2*	*1*	*10*
	SPARE		*DO*	*1*	*2*	*1*	*11*
	SPARE		*DO*	*1*	*2*	*1*	*12*

LCP-2000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
SPARE		*DO*	*1*	*2*	*1*	*13*
SPARE		*DO*	*1*	*2*	*1*	*14*
SPARE		*DO*	*1*	*2*	*1*	*15*
ME-2125	SPEED REFERENCE	23026	AI	1	2	2	0
SPARE		*AI*	*1*	*2*	*2*	*1*
P-2150	*SPEED REFERENCE*	*23046*	*AI*	*1*	*2*	*2*	*2*
SPARE		*AI*	*1*	*2*	*2*	*3*
ME-2325	*FREQUENCY*	*23096*	*AI*	*1*	*2*	*2*	*4*
ME-2325	*CURRENT*	*23100*	*AI*	*1*	*2*	*2*	*5*
FIT-2133	FLOW	23038	AI	1	2	2	6
FIT-2233	*FLOW (0-1000 SCFM)*	*23070*	*AI*	*1*	*2*	*2*	*7*
PIT-2134	PRESSURE (0-15 PSIG)	23108	AI	1	2	2	8
PIT-2234	*PRESSURE (0-15 PSIG)*	*23074*	*AI*	*1*	*2*	*2*	*9*
FCV-2231	POSITION STATUS		AI	1	2	2	10
FCV-2131	POSITION STATUS		AI	1	2	2	11
SPARE		*AI*	*1*	*2*	*2*	*12*
SPARE		*AI*	*1*	*2*	*2*	*13*
SPARE		*AI*	*1*	*2*	*2*	*14*
SPARE		*AI*	*1*	*2*	*2*	*15*
ME-2125	SPEED SETPOINT	24006 / 24008	AO	1	2	3	0
P-2150	SPEED COMMAND	24014 / 24016	AO	1	2	3	1
ME-2325	*SPEED SETPOINT*	*24050 / 24052*	*AO*	*1*	*2*	*3*	*2*
FCV-2231	FLOW SETPOINT		AO	1	2	3	3
FCV-2131	FLOW SETPOINT		AO	1	2	3	4
SPARE		*AO*	*1*	*2*	*3*	*5*
SPARE		*AO*	*1*	*2*	*3*	*6*
SPARE		*AO*	*1*	*2*	*3*	*7*
ME-2125	MOTOR RUNNING	21018	DI	1	2	4	0
ME-2125	MOTOR FAULT	21020	DI	1	2	4	1
ME-2125	INLET DIFF PRESSURE HIGH	21022	DI	1	2	4	2
ME-2125	AUTO POSITION	21024	DI	1	2	4	3
ME-2125	HAND POSITION	21026	DI	1	2	4	4
P-2150	MOTOR RUNNING	21040	DI	1	2	4	5
P-2150	MOTOR FAULT	21042	DI	1	2	4	6
P-2150	SPARE	21044	DI	1	2	4	7
P-2150	AUTO POSITION	21046	DI	1	2	4	8
P-2150	HAND POSITION	21048	DI	1	2	4	9
ME-2325	*JOG*	*21206*	*DI*	*1*	*2*	*4*	*10*
ME-2325	*IN REMOTE*	*21208*	*DI*	*1*	*2*	*4*	*11*
ME-2325	*READY*	*21210*	*DI*	*1*	*2*	*4*	*12*
ME-2325	*AUTO MODE*	*21212*	*DI*	*1*	*2*	*4*	*13*
ME-2325	*NOT FAULTED*	*21214*	*DI*	*1*	*2*	*4*	*14*
SPARE		*DI*	*1*	*2*	*4*	*15*
FCV-2231	HOA IN AUTO	21190	DI	1	2	5	0

LCP-2000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
FCV-2231	FAIL	21132	DI	1	2	5	1
FCV-2231	OPENED	21134	DI	1	2	5	2
FCV-2231	CLOSED	21378	DI	1	2	5	3
FCV-2131	HOA IN AUTO	21317	DI	1	2	5	4
FCV-2131	FAIL	21380	DI	1	2	5	5
FCV-2131	OPENED	21382	DI	1	2	5	6
FCV-2131	CLOSED	21384	DI	1	2	5	7
SPARE			*DI*	*1*	*2*	*5*	*8*
SPARE			*DI*	*1*	*2*	*5*	*9*
SPARE			*DI*	*1*	*2*	*5*	*10*
SPARE			*DI*	*1*	*2*	*5*	*11*
SPARE			*DI*	*1*	*2*	*5*	*12*
SPARE			*DI*	*1*	*2*	*5*	*13*
SPARE			*DI*	*1*	*2*	*5*	*14*
SPARE			*DI*	*1*	*2*	*5*	*15*
SPARE			*DI*	*1*	*2*	*6*	*0*
SPARE			*DI*	*1*	*2*	*6*	*1*
SPARE			*DI*	*1*	*2*	*6*	*2*
SPARE			*DI*	*1*	*2*	*6*	*3*
SPARE			*DI*	*1*	*2*	*6*	*4*
SPARE			*DI*	*1*	*2*	*6*	*5*
SPARE			*DI*	*1*	*2*	*6*	*6*
SPARE			*DI*	*1*	*2*	*6*	*7*
SPARE			*DI*	*1*	*2*	*6*	*8*
SPARE			*DI*	*1*	*2*	*6*	*9*
SPARE			*DI*	*1*	*2*	*6*	*10*
SPARE			*DI*	*1*	*2*	*6*	*11*
SPARE			*DI*	*1*	*2*	*6*	*12*
SPARE			*DI*	*1*	*2*	*6*	*13*
SPARE			*DI*	*1*	*2*	*6*	*14*
SPARE			DI	1	2	6	15
ME-2125	MOTOR OVERTEMP		DI	1	2	7	0
ME-2125	CONTROL POWER AVAILABLE		DI	1	2	7	1
ME-2125	OVER PRESSURE		DI	1	2	7	2
P-2150	MOTOR OVERTEMP		DI	1	2	7	3
P-2150	CONTROL POWER AVAILABLE		DI	1	2	7	4
P-2150	OVER PRESSURE		DI	1	2	7	5
P-2150	LOW FLOW		*DI*	*1*	*2*	*7*	*6*
SPARE			*DI*	*1*	*2*	*7*	*7*
SPARE			*DI*	*1*	*2*	*7*	*8*
SPARE			*DI*	*1*	*2*	*7*	*9*
SPARE			*DI*	*1*	*2*	*7*	*10*
SPARE			*DI*	*1*	*2*	*7*	*11*
SPARE			*DI*	*1*	*2*	*7*	*12*

LCP-2000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
SPARE			*DI*	*1*	*2*	*7*	*13*
SPARE			*DI*	*1*	*2*	*7*	*14*
SPARE			*DI*	*1*	*2*	*7*	*15*
SPARE		*22042*	*DO*	*1*	*3*	*0*	*0*
ME-2200	AUTO CALL	22044	DO	1	3	0	1
P-2350	*FAULT RESET*	*22076*	*DO*	*1*	*3*	*0*	*2*
P-2350	*CALL*	*22078*	*DO*	*1*	*3*	*0*	*3*
ME-2400	*FAULT RESET*	*22096*	*DO*	*1*	*3*	*0*	*4*
ME-2400	*CALL*	*22098*	*DO*	*1*	*3*	*0*	*5*
SPARE			*DO*	*1*	*3*	*0*	*6*
SPARE			*DO*	*1*	*3*	*0*	*7*
SPARE			*DO*	*1*	*3*	*0*	*8*
SPARE			*DO*	*1*	*3*	*0*	*9*
SPARE			*DO*	*1*	*3*	*0*	*10*
SPARE			*DO*	*1*	*3*	*0*	*11*
SPARE			*DO*	*1*	*3*	*0*	*12*
SPARE			*DO*	*1*	*3*	*0*	*13*
SPARE			*DO*	*1*	*3*	*0*	*14*
SPARE			*DO*	*1*	*3*	*0*	*15*
SPARE			*DO*	*1*	*3*	*1*	*0*
SPARE			*DO*	*1*	*3*	*1*	*1*
SPARE			*DO*	*1*	*3*	*1*	*2*
SPARE			*DO*	*1*	*3*	*1*	*3*
SPARE			*DO*	*1*	*3*	*1*	*4*
SPARE			*DO*	*1*	*3*	*1*	*5*
SPARE			*DO*	*1*	*3*	*1*	*6*
SPARE			*DO*	*1*	*3*	*1*	*7*
SPARE			*DO*	*1*	*3*	*1*	*8*
SPARE			*DO*	*1*	*3*	*1*	*9*
SPARE			*DO*	*1*	*3*	*1*	*10*
SPARE			*DO*	*1*	*3*	*1*	*11*
SPARE			*DO*	*1*	*3*	*1*	*12*
SPARE			*DO*	*1*	*3*	*1*	*13*
SPARE			*DO*	*1*	*3*	*1*	*14*
SPARE			*DO*	*1*	*3*	*1*	*15*
ME-2200	SPEED REFERENCE	23282	AI	1	3	2	0
SPARE			*AI*	*1*	*3*	*2*	*1*
P-2350	*FREQUENCY*	*23116*	*AI*	*1*	*3*	*2*	*2*
P-2350	*CURRENT*	*23120*	*AI*	*1*	*3*	*2*	*3*
ME-2400	*FREQUENCY*	*23140*	*AI*	*1*	*3*	*2*	*4*
ME-2400	*CURRENT*	*23144*	*AI*	*1*	*3*	*2*	*5*
FIT-2333	*FLOW (0-1000 SCFM)*	*23110*	*AI*	*1*	*3*	*2*	*6*
FIT-2433	FLOW	23166	AI	1	3	2	7
PIT-2334	*PRESSURE (0-15 PSIG)*	*23114*	*AI*	*1*	*3*	*2*	*8*

LCP-2000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
PIT-2434	PRESSURE	23170	AI	1	3	2	9
FCV-2331	POSITION STATUS		AI	1	3	2	10
FCV-2431	POSITION STATUS		AI	1	3	2	11
	SPARE		*AI*	*1*	*3*	*2*	*12*
	SPARE		*AI*	*1*	*3*	*2*	*13*
	SPARE		*AI*	*1*	*3*	*2*	*14*
	SPARE		*AI*	*1*	*3*	*2*	*15*
ME-2200	SPEED COMMAND	24030 / 24032	AO	1	3	3	0
P-2350	*SPEED SETPOINT*	*24058 / 24060*	*AO*	*1*	*3*	*3*	*1*
ME-2400	*SPEED SETPOINT*	*24074 / 24076*	*AO*	*1*	*3*	*3*	*2*
FCV-2331	FLOW SETPOINT		AO	1	3	3	3
FCV-2431	FLOW SETPOINT		AO	1	3	3	4
	SPARE		*AO*	*1*	*3*	*3*	*5*
	SPARE		*AO*	*1*	*3*	*3*	*6*
	SPARE		*AO*	*1*	*3*	*3*	*7*
ME-2200	MOTOR RUNNING	21066	DI	1	3	4	0
ME-2200	MOTOR FAULT	21068	DI	1	3	4	1
ME-2200	INLET DIFF PRESSURE HIGH	21040	DI	1	3	4	2
ME-2200	AUTO POSITION	21072	DI	1	3	4	3
ME-2200	HAND POSITION	21074	DI	1	3	4	4
P-2350	*JOG*	*21226*	*DI*	*1*	*3*	*4*	*5*
P-2350	*IN REMOTE*	*21228*	*DI*	*1*	*3*	*4*	*6*
P-2350	*READY*	*21230*	*DI*	*1*	*3*	*4*	*7*
P-2350	*AUTO MODE*	*21232*	*DI*	*1*	*3*	*4*	*8*
P-2350	*NOT FAULTED*	*21234*	*DI*	*1*	*3*	*4*	*9*
ME-2400	*JOG*	*21252*	*DI*	*1*	*3*	*4*	*10*
ME-2400	*IN REMOTE*	*21254*	*DI*	*1*	*3*	*4*	*11*
ME-2400	*READY*	*21256*	*DI*	*1*	*3*	*4*	*12*
ME-2400	*AUTO MODE*	*21258*	*DI*	*1*	*3*	*4*	*13*
ME-2400	*NOT FAULTED*	*21260*	*DI*	*1*	*3*	*4*	*14*
	SPARE		*DI*	*1*	*3*	*4*	*15*
FCV-2331	IN AUTO	21222	DI	1	3	5	0
FCV-2331	FAIL	21238	DI	1	3	5	1
FCV-2331	OPENED	21270	DI	1	3	5	2
FCV-2331	CLOSED	21462	DI	1	3	5	3
FCV-2431	IN AUTO	21476	DI	1	3	5	4
FCV-2431	FAIL	21464	DI	1	3	5	5
FCV-2431	OPENED	21466	DI	1	3	5	6
FCV-2431	CLOSED	21468	DI	1	3	5	7
	SPARE		*DI*	*1*	*3*	*5*	*8*
	SPARE		*DI*	*1*	*3*	*5*	*9*
	SPARE		*DI*	*1*	*3*	*5*	*10*
	SPARE		*DI*	*1*	*3*	*5*	*11*
	SPARE		*DI*	*1*	*3*	*5*	*12*

LCP-2000		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
SPARE			*DI*	*1*	*3*	*5*	*13*
SPARE			*DI*	*1*	*3*	*5*	*14*
SPARE			*DI*	*1*	*3*	*5*	*15*
SPARE			*DI*	*1*	*3*	*6*	*0*
SPARE			*DI*	*1*	*3*	*6*	*1*
SPARE			*DI*	*1*	*3*	*6*	*2*
SPARE			*DI*	*1*	*3*	*6*	*3*
SPARE			*DI*	*1*	*3*	*6*	*4*
SPARE			*DI*	*1*	*3*	*6*	*5*
SPARE			*DI*	*1*	*3*	*6*	*6*
SPARE			*DI*	*1*	*3*	*6*	*7*
SPARE			*DI*	*1*	*3*	*6*	*8*
SPARE			*DI*	*1*	*3*	*6*	*9*
SPARE			*DI*	*1*	*3*	*6*	*10*
SPARE			*DI*	*1*	*3*	*6*	*11*
SPARE			*DI*	*1*	*3*	*6*	*12*
SPARE			*DI*	*1*	*3*	*6*	*13*
SPARE			DI	1	3	6	14
SPARE			DI	1	3	6	15
ME-2200	MOTOR OVERTEMP		DI	1	3	7	0
ME-2200	CONTROL POWER AVAILABLE		*DI*	*1*	*3*	*7*	*1*
ME-2200	OVER PRESSURE		*DI*	*1*	*3*	*7*	*2*
SPARE			*DI*	*1*	*3*	*7*	*3*
SPARE			*DI*	*1*	*3*	*7*	*4*
SPARE			*DI*	*1*	*3*	*7*	*5*
SPARE			*DI*	*1*	*3*	*7*	*6*
SPARE			*DI*	*1*	*3*	*7*	*7*
SPARE			*DI*	*1*	*3*	*7*	*8*
SPARE			*DI*	*1*	*3*	*7*	*9*
SPARE			*DI*	*1*	*3*	*7*	*10*
SPARE			*DI*	*1*	*3*	*7*	*11*
SPARE			*DI*	*1*	*3*	*7*	*12*
SPARE			*DI*	*1*	*3*	*7*	*13*
SPARE			*DI*	*1*	*3*	*7*	*14*
SPARE			*DI*	*1*	*3*	*7*	*15*

LCP-2014		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
V-2506	VALVE STOP	21450	DO	3	1	1	0
V-2506	VALVE OPEN	21454	DO	3	1	1	1
V-2506	VALVE CLOSE	21456	DO	3	1	1	2
V-2606	VALVE STOP	21534	DO	3	1	1	3
V-2606	VALVE OPEN	21538	DO	3	1	1	4
V-2606	VALVE CLOSE	21540	DO	3	1	1	5
	SPARE	*22002*	*DO*	*3*	*1*	*1*	*6*
P-2100	AUTO CALL	22004	DO	3	1	1	7
P-2375	*FAULT RESET*	*22086*	*DO*	*3*	*1*	*1*	*8*
P-2375	*CALL*	*22088*	*DO*	*3*	*1*	*1*	*9*
P-2540	AUTO CALL		DO	3	1	1	10
P-2640	AUTO CALL		DO	3	1	1	11
	SPARE		*DO*	*3*	*1*	*1*	*12*
	SPARE		*DO*	*3*	*1*	*1*	*13*
	SPARE		*DO*	*3*	*1*	*1*	*14*
	SPARE		*DO*	*3*	*1*	*1*	*15*
P-2100	SPEED REFERENCE	23002	AI	3	1	2	0
PIT-2517	PRESSURE	23006	AI	3	1	2	1
P-2375	*FREQUENCY*	*23128*	*AI*	*3*	*1*	*2*	*2*
P-2375	*CURRENT*	*23132*	*AI*	*3*	*1*	*2*	*3*
P-2540	SPEED REFERENCE		AI	3	1	2	4
P-2640	SPEED REFERENCE		AI	3	1	2	5
FIT-2104	FLOW (0-XX GPM)	23014	AI	3	1	2	6
FIT-2311	FLOW	23092	AI	3	1	2	7
X-2504	TURBIDITY	23172	AI	3	1	2	8
X-2505	TURBIDITY	23176	AI	3	1	2	9
	SPARE		*AI*	*3*	*1*	*2*	*10*
FIT-2517	FLOW	23180	AI	3	1	2	11
	SPARE		*AI*	*3*	*1*	*2*	*12*
FIT-2617	FLOW	23206	AI	3	1	2	13
	SPARE		*AI*	*3*	*1*	*2*	*14*
LIT-2508	MBR #1 TANK LEVEL (0-10 FT)	23314	AI	3	1	2	15
LIT-2608	MBR #4 TANK LEVEL (0-10 FT)	23234	AI	3	1	3	0
	SPARE		*AI*	*3*	*1*	*3*	*1*
X-2604	TURBIDITY	23194	AI	3	1	3	2
X-2605	TURBIDITY	23198	AI	3	1	3	3
PIT-2617	PRESSURE		AI	3	1	3	4
FCV-2540	POSITION STATUS		AI	3	1	3	5
FCV-2640	POSITION STATUS		AI	3	1	3	6
	SPARE		*AI*	*3*	*1*	*3*	*7*
	SPARE		*AI*	*3*	*1*	*3*	*8*
	SPARE		*AI*	*3*	*1*	*3*	*9*
	SPARE		*AI*	*3*	*1*	*3*	*10*
	SPARE		*AI*	*3*	*1*	*3*	*11*
	SPARE		*AI*	*3*	*1*	*3*	*12*

LCP-2014		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
SPARE		*AI*	*3*	*1*	*3*	*13*
SPARE		*AI*	*3*	*1*	*3*	*14*
SPARE		*AI*	*3*	*1*	*3*	*15*
P-2100	SPEED COMMAND	24002 / 24004	AO	3	1	4	0
P-2375	*SPEED SETPOINT*	*24066 / 24068*	*AO*	*3*	*1*	*4*	*1*
P-2540	SPEED COMMAND		AO	3	1	4	2
P-2640	SPEED COMMAND		AO	3	1	4	3
FCV-2540	FLOW SETPOINT		AO	3	1	4	4
FCV-2640	FLOW SETPOINT		AO	3	1	4	5
SPARE			*AO*	*3*	*1*	*4*	*6*
SPARE			*AO*	*3*	*1*	*4*	*7*
V-2503	CLOSED STATUS	21272	DI	3	1	5	0
V-2503	OPEN STATUS	21274	DI	3	1	5	1
V-2603	CLOSED STATUS	21276	DI	3	1	5	2
V-2603	OPEN STATUS	21278	DI	3	1	5	3
V-2506	CONTROL POWER AVAILABLE	21434	DI	3	1	5	4
V-2506	FIELD STOP	21448	DI	3	1	5	5
V-2506	REMOTE POSITION	21436	DI	3	1	5	6
V-2506	OPEN STATUS	21438	DI	3	1	5	7
V-2506	CLOSED STATUS	21440	DI	3	1	5	8
SPARE			*DI*	*3*	*1*	*5*	*9*
SPARE			*DI*	*3*	*1*	*5*	*10*
V-2606	CONTROL POWER AVAILABLE	21518	DI	3	1	5	11
V-2606	FIELD STOP	21532	DI	3	1	5	12
V-2606	REMOTE POSITION	21520	DI	3	1	5	13
V-2606	OPEN STATUS	21522	DI	3	1	5	14
V-2606	CLOSED STATUS	21524	DI	3	1	5	15
SPARE			*DI*	*3*	*1*	*6*	*0*
SPARE			*DI*	*3*	*1*	*6*	*1*
P-2100	MOTOR RUNNING	21002	DI	3	1	6	2
P-2100	MOTOR FAULT	21004	DI	3	1	6	3
P-2100	MOTOR OVERTEMP	21006	DI	3	1	6	4
P-2100	AUTO POSITION	21008	DI	3	1	6	5
P-2100	HAND POSITION	21010	DI	3	1	6	6
P-2375	*JOG*	*21238*	*DI*	*3*	*1*	*6*	*7*
P-2375	*IN REMOTE*	*21240*	*DI*	*3*	*1*	*6*	*8*
P-2375	*READY*	*21242*	*DI*	*3*	*1*	*6*	*9*
P-2375	*AUTO MODE*	*21244*	*DI*	*3*	*1*	*6*	*10*
P-2375	*NOT FAULTED*	*21246*	*DI*	*3*	*1*	*6*	*11*
P-2100	CONTROL POWER AVAILABLE		DI	3	1	6	12
P-2100	OVER PRESSURE		DI	3	1	6	13
P-2100	LOW FLOW		DI	3	1	6	14
P-2540	MOTOR RUNNING		DI	3	1	6	15
P-2540	MOTOR FAULT		DI	3	1	7	0

LCP-2014		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
P-2540	MOTOR OVERTEMP		DI	3	1	7	1
P-2540	AUTO POSITION		DI	3	1	7	2
P-2540	HAND POSITION		DI	3	1	7	3
P-2540	CONTROL POWER AVAILABLE		DI	3	1	7	4
P-2540	OVER PRESSURE		DI	3	1	7	5
P-2640	MOTOR RUNNING		DI	3	1	7	6
P-2640	MOTOR FAULT		DI	3	1	7	7
P-2640	MOTOR OVERTEMP		DI	3	1	7	8
P-2640	AUTO POSITION		DI	3	1	7	9
P-2640	HAND POSITION		DI	3	1	7	10
P-2640	CONTROL POWER AVAILABLE		DI	3	1	7	11
P-2640	OVER PRESSURE		DI	3	1	7	12
LCP-2014	*POWER SUPPLY STATUS*		*DI*	*3*	*1*	*7*	*13*
	SPARE		*DI*	*3*	*1*	*7*	*14*
	SPARE		*DI*	*3*	*1*	*7*	*15*
	SPARE		*DI*	*2*	*1*	*8*	*0*
	SPARE		*DI*	*2*	*1*	*8*	*1*
	SPARE		*DI*	*2*	*1*	*8*	*2*
	SPARE		*DI*	*2*	*1*	*8*	*3*
	SPARE		*DI*	*2*	*1*	*8*	*4*
	SPARE		*DI*	*2*	*1*	*8*	*5*
	SPARE		*DI*	*2*	*1*	*8*	*6*
	SPARE		*DI*	*2*	*1*	*8*	*7*
	SPARE		*DI*	*2*	*1*	*8*	*8*
	SPARE		*DI*	*2*	*1*	*8*	*9*
	SPARE		*DI*	*2*	*1*	*8*	*10*
	SPARE		*DI*	*2*	*1*	*8*	*11*
	SPARE		*DI*	*2*	*1*	*8*	*12*
	SPARE		*DI*	*2*	*1*	*8*	*13*
	SPARE		*DI*	*2*	*1*	*8*	*14*
	SPARE		*DI*	*2*	*1*	*8*	*15*

LCP-2023		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
V-2406	*VALVE STOP*	*21366*	*DO*	*2*	*1*	*1*	*0*
V-2406	*VALVE OPEN*	*21370*	*DO*	*2*	*1*	*1*	*1*
V-2406	*VALVE CLOSE*	*21372*	*DO*	*2*	*1*	*1*	*2*
V-2706	*VALVE STOP*	*21618*	*DO*	*2*	*1*	*1*	*3*
V-2706	*VALVE OPEN*	*21622*	*DO*	*2*	*1*	*1*	*4*
V-2706	*VALVE CLOSE*	*21624*	*DO*	*2*	*1*	*1*	*5*
	SPARE	*22038*	*DO*	*2*	*1*	*1*	*6*
P-2175	AUTO CALL	22034	DO	2	1	1	7
P-2300	*FAULT RESET*	*22056*	*DO*	*2*	*1*	*2*	*0*
P-2300	*CALL*	*22058*	*DO*	*2*	*1*	*2*	*1*
P-2440	AUTO CALL		DO	2	1	2	2
P-2740	AUTO CALL		DO	2	1	2	3
	SPARE		*DO*	*2*	*1*	*2*	*4*
	SPARE		*DO*	*2*	*1*	*2*	*5*
	SPARE		*DO*	*2*	*1*	*2*	*6*
	SPARE		*DO*	*2*	*1*	*2*	*7*
P-2175	SPEED REFERENCE	23058	AI	2	1	3	0
	SPARE	*23062*	*AI*	*2*	*1*	*3*	*1*
P-2300	*FREQUENCY*	*23076*	*AI*	*2*	*1*	*3*	*2*
P-2300	*CURRENT*	*23080*	*AI*	*2*	*1*	*3*	*3*
P-2440	SPEED REFERENCE		AI	2	1	3	4
P-2740	SPEED REFERENCE		AI	2	1	3	5
FIT-2304	*FLOW (0-1400 GPM)*	*23088*	*AI*	*2*	*1*	*3*	*6*
FIT-2111	*FLOW (0-1400 GPM)*	*23104*	*AI*	*2*	*1*	*3*	*7*
X-2404	*TURBIDITY (0-5 NTU)*	*23298*	*AI*	*2*	*1*	*3*	*8*
X-2405	*TURBIDITY (0-5 NTU)*	*23154*	*AI*	*2*	*1*	*3*	*9*
DOT-2407	*DISSOLVED OXYGEN (0-7 MG/L)*	*23158*	*AI*	*2*	*1*	*3*	*10*
FIT-2417	*FLOW (0-300 GPM)*	*23162*	*AI*	*2*	*1*	*3*	*11*
FIT-2418	*FLOW (0-300 GPM)*	*23302*	*AI*	*2*	*1*	*3*	*12*
FIT-2717	*FLOW*	*23226*	*AI*	*2*	*1*	*3*	*13*
FIT-2718	*FLOW*	*23230*	*AI*	*2*	*1*	*3*	*14*
LIT-2739	*MBR #2 TANK LEVEL (0-10 FT)*	*23310*	*AI*	*2*	*1*	*3*	*15*
LIT-2739	*MBR #3 TANK LEVEL (0-10 FT)*	*23238*	*AI*	*2*	*1*	*4*	*0*
	SPARE	*23246*	*AI*	*2*	*1*	*4*	*1*
X-2704	*TURBIDITY*	*23214*	*AI*	*2*	*1*	*4*	*2*
X-2705	*TURBIDITY*	*23218*	*AI*	*2*	*1*	*4*	*3*
	SPARE		*AI*	*2*	*1*	*4*	*4*
FCV-2440	POSITION STATUS		AI	2	1	4	5
FCV-2740	POSITION STATUS		AI	2	1	4	6
	SPARE		*AI*	*2*	*1*	*4*	*7*
	SPARE		*AI*	*2*	*1*	*4*	*8*
	SPARE		*AI*	*2*	*1*	*4*	*9*
	SPARE		*AI*	*2*	*1*	*4*	*10*
	SPARE		*AI*	*2*	*1*	*4*	*11*
	SPARE		*AI*	*2*	*1*	*4*	*12*

LCP-2023		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
SPARE			*AI*	*2*	*1*	*4*	*13*
SPARE			*AI*	*2*	*1*	*4*	*14*
SPARE			*AI*	*2*	*1*	*4*	*15*
P-2175	SPEED COMMAND	24022 / 24024	AO	2	1	5	0
P-2300	*SPEED SETPOINT*	*24042 / 24044*	*AO*	*2*	*1*	*5*	*1*
P-2440	SPEED COMMAND		AO	2	1	5	2
P-2740	SPEED COMMAND		AO	2	1	5	3
FCV-2440	FLOW SETPOINT		AO	2	1	5	4
FCV-2740	FLOW SETPOINT		AO	2	1	5	5
SPARE			*AO*	*2*	*1*	*5*	*6*
SPARE			*AO*	*2*	*1*	*5*	*7*
V-2403	*VALVE CLOSED*	*21264*	*DI*	*2*	*1*	*6*	*0*
V-2403	*VALVE OPEN*	*21266*	*DI*	*2*	*1*	*6*	*1*
V-2703	*VALVE CLOSED*	*21280*	*DI*	*2*	*1*	*6*	*2*
V-2703	*VALVE OPEN*	*21282*	*DI*	*2*	*1*	*6*	*3*
V-2406	*CONTROL POWER AVAILABLE*	*21350*	*DI*	*2*	*1*	*6*	*4*
V-2406	*FIELD STOP*	*21317*	*DI*	*2*	*1*	*6*	*5*
V-2406	*REMOTE STATUS*	*21352*	*DI*	*2*	*1*	*6*	*6*
V-2406	*VALVE OPEN*	*21354*	*DI*	*2*	*1*	*6*	*7*
V-2406	*VALVE CLOSED*	*21356*	*DI*	*2*	*1*	*6*	*8*
V-2406	*HIGH TORQUE CLOSING*	*21358*	*DI*	*2*	*1*	*6*	*9*
V-2406	*HIGH TORQUE OPENING*	*21360*	*DI*	*2*	*1*	*6*	*10*
V-2706	*CONTROL POWER AVAILABLE*	*21602*	*DI*	*2*	*1*	*6*	*11*
V-2706	*FIELD STOP*	*21317*	*DI*	*2*	*1*	*6*	*12*
V-2706	*REMOTE STATUS*	*21604*	*DI*	*2*	*1*	*6*	*13*
V-2706	*VALVE OPEN*	*21606*	*DI*	*2*	*1*	*6*	*14*
V-2706	*VALVE CLOSED*	*21608*	*DI*	*2*	*1*	*6*	*15*
V-2706	*HIGH TORQUE CLOSING*	*21610*	*DI*	*2*	*1*	*7*	*0*
V-2706	*HIGH TORQUE OPENING*	*21612*	*DI*	*2*	*1*	*7*	*1*
P-2175	MOTOR RUNNING	21052	DI	2	1	7	2
P-2175	MOTOR FAULT	21054	DI	2	1	7	3
P-2175	MOTOR OVERTEMP	21056	DI	2	1	7	4
P-2175	AUTO POSITION	21058	DI	2	1	7	5
P-2175	HAND POSITION	21060	DI	2	1	7	6
P-2300	*JOG*	*21192*	*DI*	*2*	*1*	*7*	*7*
P-2300	*IN REMOTE*	*21194*	*DI*	*2*	*1*	*7*	*8*
P-2300	*RUNNING*	*21196*	*DI*	*2*	*1*	*7*	*9*
P-2300	*AUTO MODE*	*21198*	*DI*	*2*	*1*	*7*	*10*
P-2300	*NOT FAULTED*	*21200*	*DI*	*2*	*1*	*7*	*11*
P-2175	CONTROL POWER AVAILABLE		DI	2	1	7	12
P-2175	OVER PRESSURE		DI	2	1	7	13
P-2175	LOW FLOW		DI	2	1	7	14
P-2440	MOTOR RUNNING		DI	2	1	7	15
P-2440	MOTOR FAULT		DI	2	1	8	0

LCP-2023		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
P-2440	MOTOR OVERTEMP		DI	2	1	8	1
P-2440	AUTO POSITION		DI	2	1	8	2
P-2440	HAND POSITION		DI	2	1	8	3
P-2440	CONTROL POWER AVAILABLE		DI	2	1	8	4
P-2440	OVER PRESSURE		DI	2	1	8	5
P-2740	MOTOR RUNNING		DI	2	1	8	6
P-2740	MOTOR FAULT		DI	2	1	8	7
P-2740	MOTOR OVERTEMP		DI	2	1	8	8
P-2740	AUTO POSITION		DI	2	1	8	9
P-2740	HAND POSITION		DI	2	1	8	10
P-2740	CONTROL POWER AVAILABLE		DI	2	1	8	11
P-2740	OVER PRESSURE		DI	2	1	8	12
SPARE			*DI*	*2*	*1*	*8*	*13*
SPARE			*DI*	*2*	*1*	*8*	*14*
SPARE			*DI*	*2*	*1*	*8*	*15*
SPARE			*DI*	*2*	*1*	*9*	*0*
SPARE			*DI*	*2*	*1*	*9*	*1*
SPARE			*DI*	*2*	*1*	*9*	*2*
SPARE			*DI*	*2*	*1*	*9*	*3*
SPARE			*DI*	*2*	*1*	*9*	*4*
SPARE			*DI*	*2*	*1*	*9*	*5*
SPARE			*DI*	*2*	*1*	*9*	*6*
SPARE			*DI*	*2*	*1*	*9*	*7*
SPARE			*DI*	*2*	*1*	*9*	*8*
SPARE			*DI*	*2*	*1*	*9*	*9*
SPARE			*DI*	*2*	*1*	*9*	*10*
SPARE			*DI*	*2*	*1*	*9*	*11*
SPARE			*DI*	*2*	*1*	*9*	*12*
SPARE			*DI*	*2*	*1*	*9*	*13*
SPARE			*DI*	*2*	*1*	*9*	*14*
SPARE			*DI*	*2*	*1*	*9*	*15*

LCP-3600		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
P-3201	Jog	31002	DI	1	1	1	0
P-3201	In Remote	31004	DI	1	1	1	1
P-3201	Ready	31006	DI	1	1	1	2
P-3201	Auto Mode	31008	DI	1	1	1	3
P-3201	Not Faulted	31010	DI	1	1	1	4
	Spare	31012	DI	1	1	1	5
	Spare	31014	DI	1	1	1	6
	Spare	31016	DI	1	1	1	7
	Spare	31018	DI	1	1	1	8
P-3202	Jog	31292	DI	1	1	1	9
P-3202	In Remote	31294	DI	1	1	1	10
P-3202	Ready	31296	DI	1	1	1	11
P-3202	Auto Mode	31298	DI	1	1	1	12
P-3202	Not Faulted	31300	DI	1	1	1	13
	Spare	31302	DI	1	1	1	14
	Spare	31304	DI	1	1	1	15
P-3203	Jog	31022	DI	1	1	2	0
P-3203	In Remote	31024	DI	1	1	2	1
P-3203	Ready	31026	DI	1	1	2	2
P-3203	Auto Mode	31028	DI	1	1	2	3
P-3203	Not Faulted	31030	DI	1	1	2	4
	Spare	31032	DI	1	1	2	5
	Spare	31034	DI	1	1	2	6
	Spare	31036	DI	1	1	2	7
	Spare	31038	DI	1	1	2	8
	Spare	31040	DI	1	1	2	9
P-3251	Jog	31042	DI	1	1	2	10
P-3251	In Remote	31044	DI	1	1	2	11
P-3251	Ready	31046	DI	1	1	2	12
P-3251	Auto Mode	31048	DI	1	1	2	13
P-3251	Not Faulted	31050	DI	1	1	2	14
P-3251	Spare	31052	DI	1	1	2	15
P-3252	Jog	31054	DI	1	1	3	0
P-3252	In Remote	31056	DI	1	1	3	1
P-3252	Ready	31058	DI	1	1	3	2
P-3252	Auto Mode	31060	DI	1	1	3	3
P-3252	Not Faulted	31062	DI	1	1	3	4
	Spare	31064	DI	1	1	3	5
	Spare	31066	DI	1	1	3	6
	Spare	31068	DI	1	1	3	7
	Spare	31070	DI	1	1	3	8
	Spare	31072	DI	1	1	3	9
P-3253	Jog	31074	DI	1	1	3	10
P-3253	In Remote	31076	DI	1	1	3	11
P-3253	Ready	31078	DI	1	1	3	12

LCP-3600		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
P-3253	Auto Mode	31080	DI	1	1	3	13
P-3253	Not Faulted	31082	DI	1	1	3	14
	Spare	31084	DI	1	1	3	15
P-3254	Jog	31086	DI	1	1	4	0
P-3254	In Remote	31088	DI	1	1	4	1
P-3254	Ready	31090	DI	1	1	4	2
P-3254	Auto Mode	31092	DI	1	1	4	3
P-3254	Not Faulted	31094	DI	1	1	4	4
	Spare	31096	DI	1	1	4	5
	Spare	31098	DI	1	1	4	6
	Spare	31100	DI	1	1	4	7
P-3365	Pump Running	31208	DI	1	1	4	8
P-3370	Pump Running	31210	DI	1	1	4	9
FS-3391	Emergency Shower Flow	31212	DI	1	1	4	10
	Spare	31214	DI	1	1	4	11
	Spare	31216	DI	1	1	4	12
	Spare	31218	DI	1	1	4	13
	Spare	31220	DI	1	1	4	14
	Spare	31222	DI	1	1	4	15
LCP-3600	Horn Silence	31322	DI	1	1	5	0
LCP-3600	Alarm Acknowledge	31324	DI	1	1	5	1
LCP-3600	Alarm Reset	31326	DI	1	1	5	2
LCP-3600	Lamp Test	31328	DI	1	1	5	3
	Spare	31224	DI	1	1	5	4
	Spare	31226	DI	1	1	5	5
	Spare	31228	DI	1	1	5	6
	Spare	31230	DI	1	1	5	7
PS-3207	Pressure High	31290	DI	1	1	5	8
PS-3256	Pressure High	31248	DI	1	1	5	9
	Spare	31280	DI	1	1	5	10
	Spare	31252	DI	1	1	5	11
	Spare	31254	DI	1	1	5	12
	Spare	31256	DI	1	1	5	13
	Spare	31258	DI	1	1	5	14
	Spare	31260	DI	1	1	5	15
V-3177	Control Power Available	31262	DI	1	1	6	0
V-3177	Field Stop	21317	DI	1	1	6	1
V-3177	Remote Status	31264	DI	1	1	6	2
V-3177	Valve Open	31266	DI	1	1	6	3
V-3177	Valve Closed	31268	DI	1	1	6	4
V-3177	High Torque Closing	31270	DI	1	1	6	5
V-3177	High Torque Opening	31272	DI	1	1	6	6
	Spare	31274	DI	1	1	6	7
P-3271	Control Power Available	31102	DI	1	1	7	0

LCP-3600		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
P-3271	Motor Running	31104	DI	1	1	7	1
P-3271	Overload Trip	31106	DI	1	1	7	2
P-3271	MCC in Hand	31108	DI	1	1	7	3
P-3271	MCC in Auto	31110	DI	1	1	7	4
P-3271	Field - Jog	31112	DI	1	1	7	5
P-3271	Field in Remote	31114	DI	1	1	7	6
	Spare	31116	DI	1	1	7	7
P-3285	Control Power Available	31132	DI	1	1	8	0
P-3285	Motor Running	31134	DI	1	1	8	1
P-3285	Overload Trip	31136	DI	1	1	8	2
P-3285	MCC in Hand	31138	DI	1	1	8	3
P-3285	MCC in Auto	31140	DI	1	1	8	4
P-3285	Field - Jog	31142	DI	1	1	8	5
P-3285	Field in Remote	31144	DI	1	1	8	6
	Spare	31146	DI	1	1	8	7
P-3286	Control Power Available	31162	DI	1	1	9	0
P-3286	Motor Running	31164	DI	1	1	9	1
P-3286	Overload Trip	31166	DI	1	1	9	2
P-3286	MCC in Hand	31168	DI	1	1	9	3
P-3286	MCC in Auto	31170	DI	1	1	9	4
P-3286	Field - Jog	31172	DI	1	1	9	5
P-3286	Field in Remote	31174	DI	1	1	9	6
	Spare	31176	DI	1	1	9	7
V-3177	Valve Stop	31278	DO	1	1	10	0
V-3177	Valve Open	31282	DO	1	1	10	1
V-3177	Valve Close	31284	DO	1	1	10	2
	Spare	31288	DO	1	1	10	3
P-3201	Fault Reset	32002	DO	1	1	10	4
P-3201	Call	32004	DO	1	1	10	5
	Spare	32008	DO	1	1	10	6
	Spare	32012	DO	1	1	10	7
P-3202	Fault Reset	32016	DO	1	1	11	0
P-3202	Call	32018	DO	1	1	11	1
	Spare	32022	DO	1	1	11	2
P-3203	Fault Reset	32026	DO	1	1	11	3
P-3203	Call	32028	DO	1	1	11	4
	Spare	32032	DO	1	1	11	5
P-3251	Fault Reset	32036	DO	1	1	11	6
P-3251	Call	32038	DO	1	1	11	7
P-3252	Fault Reset	32042	DO	1	2	0	0
P-3252	Call	32044	DO	1	2	0	1
	Spare	32048	DO	1	2	0	2
P-3253	Fault Reset	32052	DO	1	2	0	3
P-3253	Call	32054	DO	1	2	0	4

LCP-3600		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
	Spare	32058	DO	1	2	0	5
P-3254	Fault Reset	32062	DO	1	2	0	6
P-3254	Call	32064	DO	1	2	0	7
P-3271	Ready	31120	DO	1	2	1	0
P-3271	Jog Call	31122	DO	1	2	1	1
P-3271	Auto Call	31122	DO	1	2	1	2
	Spare	31128	DO	1	2	1	3
P-3285	Ready	31150	DO	1	2	1	4
P-3285	Jog Call	31152	DO	1	2	1	5
P-3285	Auto Call	31152	DO	1	2	1	6
	Spare	31158	DO	1	2	1	7
P-3286	Ready	31180	DO	1	2	2	0
P-3286	Jog Call	31182	DO	1	2	2	1
P-3286	Auto Call	31182	DO	1	2	2	2
	Spare	31188	DO	1	2	2	3
	Spare	31192	DO	1	2	2	4
	Spare	31196	DO	1	2	2	5
	Spare	31200	DO	1	2	2	6
	Spare	31204	DO	1	2	2	7
LCP-3600	Alarm Horn		DO	1	2	3	0
LCP-3600	Sonalert	31308N	DO	1	2	3	1
	Spare	31310	DO	1	2	3	2
	Spare	31312	DO	1	2	3	3
	Spare	31314	DO	1	2	3	4
	Spare	31316	DO	1	2	3	5
	Spare	31318	DO	1	2	3	6
	Spare	31320	DO	1	2	3	7
xxxx No.1	Tank Level (0-36 in.)	33000	AI	1	2	4	0
xxxx No.2	Tank Level (0-36 in.)	33004	AI	1	2	4	1
xxxx No.3	Tank Level (0-36 in.)	33008	AI	1	2	4	2
xxxx No.4	Tank Level (0-36 in.)	33012	AI	1	2	4	3
xxxx No.1	Tank Level (0-5 ft.)	33016	AI	1	2	4	4
xxxx No.2	Tank Level (0-20 ft)	33020	AI	1	2	4	5
xxxx No.3	Tank Level (0-20 ft)	33024	AI	1	2	4	6
xxxx No.4	Tank Level (0-20 ft)	33028	AI	1	2	4	7
	Spare	33182	AI	1	2	4	8
TK-3150	AIT-3152 (Future)	33186	AI	1	2	4	9
P-3201	Frequency	33032	AI	1	2	4	10
P-3201	Current	33036	AI	1	2	4	11
	Spare	33040	AI	1	2	4	12
P-3202	Frequency	33044	AI	1	2	4	13
P-3202	Current	33048	AI	1	2	4	14
	Spare	33052	AI	1	2	4	15
P-3203	Frequency	33056	AI	1	2	5	0

LCP-3600		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
P-3203	Current	33060	AI	1	2	5	1
	Spare	33064	AI	1	2	5	2
Re-Use	Flow (0-1000 GPM)	33068	AI	1	2	5	3
Re-Use	Pressure (0-110 PSIG)	33072	AI	1	2	5	4
Effluent	Residual Chlorine	33074	AI	1	2	5	5
P-3251	Frequency	33078	AI	1	2	5	6
P-3251	Current	33082	AI	1	2	5	7
	Spare	33086	AI	1	2	5	8
P-3252	Frequency	33090	AI	1	2	5	9
P-3252	Current	33094	AI	1	2	5	10
	Spare	33098	AI	1	2	5	11
P-3253	Frequency	33102	AI	1	2	5	12
P-3253	Current	33106	AI	1	2	5	13
	Spare	33110	AI	1	2	5	14
	Spare	33114	AI	1	2	5	15
P-3254	Frequency	33118	AI	1	2	6	0
P-3254	Current	33122	AI	1	2	6	1
	Spare	33125	AI	1	2	6	2
Environmental Discharge	Flow (0-xx GPM)	33130	AI	1	2	6	3
	Spare	33134	AI	1	2	6	4
	Spare	33138	AI	1	2	6	5
	Spare	33142	AI	1	2	6	6
	Spare	33146	AI	1	2	6	7
	Spare	33150	AI	1	2	6	8
	Spare	33154	AI	1	2	6	9
	Spare	33158	AI	1	2	6	10
	Spare	33162	AI	1	2	6	11
	Spare	33166	AI	1	2	6	12
	Spare	33170	AI	1	2	6	13
	Spare	33174	AI	1	2	6	14
	Spare	33178	AI	1	2	6	15
P-3201	Speed Setpoint	34000 / 34002	AO	1	2	7	0
	Spare	34004 / 34006	AO	1	2	7	1
P-3202	Speed Setpoint	34008 / 34010	AO	1	2	7	2
	Spare	34012 / 34014	AO	1	2	7	3
P-3203	Speed Setpoint	34016 / 34018	AO	1	2	7	4
	Spare	34020 / 34022	AO	1	2	7	5
P-3251	Speed Setpoint	34024 / 34026	AO	1	2	7	6
	Spare	34028 / 34030	AO	1	2	7	7
P-3252	Speed Setpoint	34032 / 34034	AO	1	2	8	0
	Spare	34036 / 34038	AO	1	2	8	1
P-3253	Speed Setpoint	34040 / 34042	AO	1	2	8	2
	Spare	34044 / 34046	AO	1	2	8	3
P-3254	Speed Setpoint	34048 / 34050	AO	1	2	8	4

LCP-3600		SOURCE / I/O		COMPACTLOGIX			
EQUIPMENT	DESCRIPTION	WIRE	TYPE	PLC	RACK	SLOT	I/O
Spare		*34052 / 34054*	*AO*	*1*	*2*	*8*	*5*
Spare		*34056 / 34058*	*AO*	*1*	*2*	*8*	*6*
Spare		*34060 / 34062*	*AO*	*1*	*2*	*8*	*7*