

DIVISION 16 – ELECTRICAL

SECTION 16010 – GENERAL PROVISIONS

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PART 1 GENERAL

1.01 Work Included

- .1 Provide all labour, materials, equipment, services and supervision required to provide a complete electrical system as listed herein and shown on the drawings.
- .2 This shall generally include work in the following areas:
 - a) Robertson Creek Cold Water Pumphouse, approximately 15km from Port Alberni, BC
 - b) The work is mainly focused on replacing an aged MCC with a new MCC complete with new VFDs for motor control. The MCC will include provision for 2 new well pumps. The MCC shall be replaced during the winter low water usage time and be in service by April 14th, 2017.
- .3 This includes, but is not limited by the generality of the following:
 - a) Secondary Feeders and Ducts
 - b) Secondary Distribution Panels
 - c) Motor Control
 - d) Control Panels
 - e) Testing and Commissioning
 - f) Extension of the concrete housekeeping pad under the MCC to match existing.
 - g) Testing and marking the rotation of each existing 3 phase motor prior to disconnecting power to the MCC and/or each motor. Then confirming phase rotation of each 3 phase motor as it is connected to the new MCC.
- .4 The MCC shall be manufactured and delivered to site by early March 2017. All work is to be completed by April 14th 2017
- .5 The work at the Pumphouse can begin any time after November 1, 2016 and shall be functional by April 14th, 2017. The power can be completely disconnected so long as the contractor provides freeze protection for piping in the building.

1.02 Work Not Included

- .1 The following work will be done by others. The Contractor shall co-ordinate his work with the following work and co-operate where required:
 - a) Work outside of the Cold Water Pumphouse, comprising of trenching, wiring to Well Heads, Well Pumps, and flowmeter (This work will be done by others under a separate contract)

1.03 Contract Drawings

- .1 The electrical drawings do not show structural details.
- .2 Accurate dimensions shall be taken from structural or architectural drawings or by measurement of the buildings. The electrical drawings show approximate location of apparatus, equipment and wiring. The arrangement is diagrammatic in some areas. The exact location of apparatus, equipment and wiring shall be determined in the field in accordance with good practice and shall be approved by the Engineer prior to installation.
- .3 Check the location of all items fed by conduit embedded in or below the floor slab. Ensure that the conduit is located correctly.
- .4 Ensure adequate clearance in front of all electrical panels and equipment.
- .5 Check all electrical equipment and motor nameplates to ensure that the breakers, fuses, overload heaters and conductor is sized in accordance with Canadian Electrical Code requirements.
- .6 Check all equipment against the Single Line Diagram to ensure that the voltage and frequency are correct.
- .7 The drawings show sufficient detail to indicate the scope of work. Minor changes may be made after award of contract, and after receipt of shop drawings. Changes made as a result of receiving the Contractor's shop drawings shall not be considered extra work.
- .8 The Engineer reserves the right to change the location of equipment, switches, outlets, etc., to within 3000mm of points indicated on drawings without involving an extra, providing the electrical trade is advised of the change in time to avoid removal of material already installed.
- .9 Obtain ruling, prior to tender closing, from Engineer, on any discrepancy between specification and drawings. If this is not done, the expensive alternative will be assumed.
- .10 Arrange wiring and apparatus to conform to architectural and structural details, in approved manner.

1.04 Shop Drawings

- .1 Submit six hard copies or a pdf of shop drawings to the Engineer for approval.
- .2 Shop drawings shall include catalogue sheets, manufacturer's bulletins, wiring diagrams, dimensional data and operating descriptions of all items listed under Part 2 Products, in each section of the Specification.

- .3 Shop drawings shall include an interconnection diagram showing terminal numbers, number of conductors between components and requirements of interwiring conductors. This shall include any requirements for shielding, twisting of pairs, minimum and maximum resistance, capacitance, reactance, etc.
- .4 Submit breaker trip curves and fuse curves for all breakers or fuses of more than 50 ampere rating.
- .5 The Engineer will check shop drawings. Approval of shop drawings does not relieve the Contractor from the requirement to provide equipment and systems in accordance with this specification and the contract drawings.
- .6 The Contractor shall also check manufacturer's shop drawings. He shall ensure that the drawings and equipment meet the requirements of this specification.

1.05 As-Built Drawings

- .1 Maintain one set of white prints on jobsite for recording of field changes to conduit runs, equipment locations, etc. As-built markups shall be done daily. Deliver set to Engineer at job completion.
- .2 As-built markups shall be to the same standard and detail as the contract drawings. Markups shall be to scale, or dimensions shall be noted. They shall show all changes made by the Engineer, Owner and Contractor.
- .3 The Contractor shall submit as-built drawings to the Engineer for inspection, when the Engineer is on site to inspect the Contractor's work.
- .4 If the Engineer finds that the final as-built drawings do not accurately reflect the work done, he shall return them to the Contractor for revision. If the Contractor does not resubmit adequate and correct drawings within 7 days, the Engineer will mark up as-built prints to final and correct state. The Engineer's cost for this work will be deducted from the Contractor's final payment.

1.06 Maintenance and Operating Manuals, Spare Parts Lists

- .1 Four copies of the manufacturer's maintenance instructions, operating manuals and spare parts lists shall be supplied by the Contractor to the Engineer on job completion showing each major piece of electrical equipment and/or equipment as designated by the Engineer. Instructions shall be complete with installation, operating and maintenance drawings and shall include one corrected copy of all shop drawings. Catalog details of all equipment actually installed, including schematic drawings layouts and maintenance data as applicable shall be included in the maintenance instructions.
- .2 All four copies of maintenance instructions and operating manuals shall be bound in separate hard back cover folders, complete with index and tabs

1.07 Guarantee

- .1 The Contractor shall guarantee his work, equipment and materials supplied for a period of one year after final completion. He shall repair, replace or otherwise make good any part or all of the electrical installation should any failure, malfunction or deficiency become known during that period. This work shall be done at no cost to the Owner.

PART 2 PRODUCTS

2.01 Materials and Equipment

- .1 Provide new and CSA approved equipment, free of defects. Factory seconds will not be accepted. Equipment shall carry an approval label.
- .2 Other agencies, acceptable to the BC Safety Authority, will be considered as equal to CSA. They include:
- a) CGA - Canadian Gas Association
 - b) ULC - Underwriter Laboratories of Canada
 - c) ITS - Intertek Testing Services NA Ltd., (ITS - Canadian Divisions) formerly Warnock Hersey Professional Services Ltd. (label is still a stylized WH)
 - d) ETL - Intertek Testing Services NA Inc., (ITS - US Division) formerly ETL Testing Laboratories (label is still ETL)
 - e) cUL - Underwriters Laboratories Inc.
 - f) cMET - MET Laboratories Inc.

The above labels should be affixed to the various components within a control panel, and the control panel itself should have an approval label.

If approval labels are missing the Contractor shall arrange for the BC Safety Authority to inspect and approve (usually at the job site) the equipment, under the SPECIAL INSPECTION PROGRAM. All costs shall be born by the Contractor.

- .3 Install all materials and equipment in accordance with the manufacturer's recommendations.
- .4 All equipment and systems shall meet WorkSafe BC (WSBC) requirements.
- .5 Provide WHMIS data sheets on all equipment and material, where required by WSBC.

2.02 Equals and Substitutions

- .1 Where equipment and materials is specified by manufacturer, "or approved equal" is implied unless specifically noted otherwise. Submit full technical data with request for approval of equals, a minimum of 5 days prior to tender closing.
- .2 Contractors who supply approved equals shall furnish revised wiring and mounting details where required. The Contractor shall pay for all additional Engineering costs related to installation of substituted equipment.
- .3 As-built drawings shall show the revised wiring, mounting and other details.

2.03 Names of Suppliers, Manufacturers & Distributors

- .1 The Contractor shall provide, with his tender, a list of all manufacturers and their distributors or suppliers, who will supply equipment listed in the "Part 2 - Products," sections of this specification.
- .2 This list shall be detailed, item by item, or summarized in categories as follows:
 - a) Motor Control Centres & Motor Starters
- .3 Where items are omitted from this list and the material has not been given "approved equal" status, the Engineer or Owner may request that this material be changed, at any stage during construction, at no expense to the Engineer or Owner.
- .4 Contractors shall not change listed suppliers following tender close without written permission from the Engineer.

PART 3 EXECUTION

3.01 Site Inspection

- .1 Examine construction site prior to submitting tender and ascertain all conditions affecting work. Base tender on site conditions. Advise Engineer of any potential problems observed during the site visit, within 24 hours of visit.

3.02 Permits, Licenses and Fees

- .1 Submit drawings to all inspection authorities for approval.
- .2 Apply and pay for all required permits, licences and fees. Supply inspection certificates to the Owner at the end of the job. Work shall not be considered complete until these certificates are submitted to the Owner.

3.03 Codes

- .1 Perform work in accordance with Canadian Electrical Code, current edition, and local and regional authorities having jurisdiction.
- .2 Perform work in accordance with WCB requirements.

3.04 Safety

- .1 Contractor shall be responsible for the safety of all personnel, his and others, working on the electrical equipment.
- .2 Contractor shall establish lock-out procedures and enforce these procedures.
- .3 Contractor shall provide training and instruction as required for all his personnel, and others working on the electrical equipment.
- .4 Contractor shall obtain assistance from outside agencies or specialists, where required, to insure a safe operating workplace.
- .5 The workplace shall be kept neat and tidy during construction. Tools will not be left exposed while not in use, and material shall not be allowed to accumulate in the work area.

3.05 Excavation, Backfill, Cutting and Patching

- .1 All excavation, backfill, cutting and patching required for electrical installation, will be by the General Contractor.

3.06 Equipment Identification

- .1 All field components shall be clearly labelled with lamicoid labels. Labels shall have minimum 3mm white letters on black background. Dymo tape labels are not acceptable. Submit list for approval with shop drawings.

3.07 Conduit and Cable Identification

- .1 All conduits and cables - power and control, shall be clearly identified with cable numbers as shown on the drawings, at the starters, MCC or Control Panel(s) and point of termination. Provide Electrovert "strap-on S markers" or T & B Tyrap or Raychem TM3 identification cable ties with indelible marking.
- .2 Conduits shall be labelled at least once on every building floor.

3.08 Testing

- .1 All electrical power, control and alarm systems shall be tested and calibrated by the Contractor to ensure that they are operating in accordance with the intent of the drawings and specifications. If the Contractor is in doubt as to the intent he shall obtain clarification prior to tender closing.
- .2 The Contractor shall supply all necessary instruments, meters, equipment and qualified personnel to make tests on electrical equipment and wiring during construction or after installation when requested by the Engineer.

The tests shall include:

- a) Insulation resistance tests in accordance with the Canadian Electrical Code before energization of any circuits or equipment.
- b) All tests as recommended in manufacturer's instructions.
- c) Phase rotation tests on circuits, motors, etc.
- d) Tests of adequacy of grounding system and connections.
- e) Complete functional test of all electrical systems.

Where tests are optional, it shall be presumed to be included unless this is highlighted in the tender, and approval to delete the test in question has been given.

- .3 The Contractor shall troubleshoot and replace all defective equipment, systems and wiring discovered during his testing program. He shall retain such competent personnel, suppliers, representatives or subcontractors as necessary to complete this work. He shall retest all systems where remedial action was necessary. After he is completely satisfied that everything is completely operational he shall inform the Engineer that he is ready for startup. He shall submit the test report at this time.

3.09 **Test Report**

- .1 The test report shall include all calibration calculations and shall show all setpoints as left. It shall include the following data on motors:
 - a) Nameplate full load current
 - b) Measured current at maximum load
 - c) Cat. No. and current range of installed O/L heater
 - d) Settings of circuit breakers and Motor Circuit Protectors (MCPs)
 - e) Settings of all protective relays

3.10 **Startup**

- .1 The Contractor shall completely test and demonstrate the system to the satisfaction of the Engineer. This test shall include but not be limited by the generality of the following:
 - a) Motor Control
 - i. All alarm points
 - ii. All interlocks
 - iii. All shutdowns
 - iv. All meters
 - v. All protective relay settings
 - vi. All control pushbuttons and switches
 - vii. All pilot lights
 - viii. Ampere readings on all motors
 - b) Instrumentation
 - i. All setpoints
 - ii. All control functions
 - iii. All pressure readings
 - iv. All temperature readings
 - v. All flow readings
 - c) Alarm Systems
 - i. Each actuating device
 - ii. Each signalling device
 - iii. Interlocks

3.11 Startup Co-ordination

- .1 The Contractor shall co-ordinate the startup of the facilities in co-operation with the Owner, Engineer, other contractors on site and the various vender representatives on site.

3.12 Special Areas

- .1 The Contractor shall follow accepted practices and code regulations in hazardous locations, areas requiring weatherproof construction, and areas subject to extreme temperatures or vibrations.

3.13 Making Good

- .1 The Contractor shall make good any damage or destruction caused by him to the structures and equipment or work of other trades on this project.

3.14 Protection of Work

- .1 The Contractor shall properly cover and protect from damage and weather, all equipment and material related to his work.

3.15 Clean-Up

- .1 Upon completion of the work, the Contractor shall remove all tools, debris, and surplus material, and shall leave the area neat and clean to the Engineer's satisfaction.

3.16 Co-ordination

- .1 The Contractor shall co-ordinate the supply of information between all suppliers and manufacturers of electrical equipment to insure that electricians in the field have correct and adequate information to install all equipment.

3.17 Workmanship

- .1 Work shall be done in accordance with good practice and by tradesmen accredited and skilled in the performance of electrical work.
- .2 The Engineer shall determine whether workmanship is acceptable. Work approved by the Electrical Inspector or other authorities may still be rejected by the Engineer.

- .3 Grounds for rejection shall be any one of, but not limited by the following:
- Poor appearance
 - Poor quality materials
 - Conduit or wiring connections incompatible with standard of enclosures used
 - Insufficient support or fastenings
 - Materials installed in a manner or location that will impede other trades or make future maintenance awkward, costly or impossible.

3.18 Supplier Responsibilities

- .1 The Contractor shall be responsible for insuring that all his suppliers of equipment and material have sufficient information to determine whether their equipment and material is suitable for the intended use shown in these documents.
- .2 The Contractor shall notify his suppliers as follows:
- a) All suppliers shall insure their equipment and material is suitable for the installation intended. If his equipment is found to be deficient, it shall be removed and replaced with suitable equipment, all at no cost to the Owner.
 - b) The supplier shall insure when applying for "equal" status to specified equipment, that his equipment is truly equal. If his equipment is discovered to be deficient in this respect, it shall be removed and the specified equipment supplied, all at no cost to the Owner or Engineer.

3.19 Earthquake Restraint

- .1 The Contractor shall provide earthquake restraint for all wall mounted equipment. Wall mounted equipment shall be firmly bolted to wall brackets. Supports, anchors and bracing shall prevent horizontal movement or tipping of wall mounted equipment during and after earthquakes.

3.20 Inspection of Work

- .1 On this project the Electrical Engineer, Owner and Electrical Safety Branch will be inspecting electrical work at various stages of construction.
- .2 The electrical contractor and/or general contractor shall notify the Electrical Engineer a minimum of two weeks prior to rough-in completion and wall boarding in order to schedule rough-in inspection. Failure to request rough-in inspection may result in the stopping of work on site by the local building inspector. This is due to the current BC Building Code requirement for field review by the Electrical Engineer.

- .3 Provide minimum two weeks advance notice of request for substantial completion and final inspection.

3.21 **Alternatives**

- .1 Bidders are encouraged to make alternative proposals where they feel that an alternative would be of advantage to the Owner.

DIVISION 16 – ELECTRICAL

SECTION 16100 – BASIC MATERIALS

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PART 1 GENERAL

1.01 Wiring Method

- .1 Wiring method shall be surface run conduit and wire, except where specifically noted otherwise herein or on the drawings.
- .2 All conduit and wiring is not shown on the drawings. The Contractor shall provide conduit and wiring as per circuit numbers shown. He shall install this in accordance with good practice with no conflicts with other trades.
- .3 Interior control panel wiring shall be "TY-RAP'ed" bundles, secured to rear mounting panel, or installed in "Panduit" type wiring trough.

1.02 Ground Conductor

- .1 Provide separate ground conductor in all non-metallic conduit and duct, except for primary underground duct and telephone service duct.

PART 2 PRODUCTS

2.01 Conduit

- .1 Provide galvanized steel electrometallic tubing in all areas, except where direct buried or exposed to mechanical damage.
- .2 Provide rigid PVC duct (DB2) CSA 22.2 No. 211.1 - M1984 where direct buried or encased in concrete. Use approved jointing cement. Run ground conductor.
- .3 Provide rigid PVC conduit CSA 22.2 No. 211.2 - M1984 where rigid PVC is surface run. Use approved jointing cement. Run ground conductor.
- .4 Provide rigid hot dipped galvanized steel in areas where exposed to mechanical damage.
- .5 Areas where conduit is exposed to mechanical damage are as follows:
 - a) Surface mounted outdoors, from 600mm below ground to 1600mm above ground.
 - b) Stubbed up through floor to motors and control pilot devices.
 - c) Where noted on drawings.
- .6 All conduit shown is 21mm diameter unless otherwise noted, or where the code calls for a larger size because of conduit fill.

- .7 Provide flexible conduit for last 500mm of connection to motors, solenoid valves, pressure switches and similar devices.

2.02 Flexible Conduit

- .1 Provide flexible water tight conduit for connections to pump bases.
- .2 Flexible conduit shall be Hydrotite or Sealtight with extruded PVC Jacket.
- .3 Non-metallic flexible conduit is acceptable.

2.03 Wire

- .1 Provide stranded copper conductor unless otherwise noted.
- .2 Provide extra flexible switchboard wire #16 AWG for all control panel wiring.
- .3 Provide RW90 X-LINK polyethylene insulated wire unless otherwise noted.
- .4 Wiring at 120/208 volts shall be 300 volt insulated.
- .5 Wiring at 600 volts shall be 600 volt insulated.

2.04 Teck Cable

- .1 Teck cable shall be aluminum armoured copper conductor with X-link insulation complete with fire retardant PVC jacket overall. Voltage rating shall be minimum 600 volt for #10 AWG and smaller, 1000 V for #8 AWG and larger.

2.05 Cable Tray

- .1 Provide cable tray for multiple runs of Teck cable in buildings.
- .2 Provide Burndy type A30 aluminum cable ladder with 300mm rung spacing, supported in accordance with manufacturer's recommendations. Size in accordance with drawings.
- .3 Provide factory fabricated tee, elbow, angle and special fittings as required.

2.06 Connectors

- .1 Teck connectors shall be raintight. Provide Thomas & Betts "Spin on 2" connectors.
- .2 EMT connectors shall be bushed steel.
- .3 Connectors shall match the EEMAC standard of the box, fitting or enclosure they enter.

2.07 Waterstop Sealant

- .1 Provide GE RTV 108 general purpose silicone rubber adhesive sealant.

2.08 Duct Seal

- .1 Provide Iberville Duct Sealant DUCT-1.

PART 3 EXECUTION

3.01 Conduit

- .1 Exposed conduit shall be parallel or perpendicular to building lines.
- .2 Provide expansion joints where required.
- .3 Provide thermal breaks where required.
- .4 Support conduit to eliminate visible deflection.
- .5 All G.F.I. protected circuits shall be in rigid PVC conduit.
- .6 Conduit installed in areas where building finish is painted, shall be painted to match, with two coats of same colour, type and quality.
- .7 Conduit entering, or passing through an electrical enclosure or kiosk shall have locknut and washer on both sides of the enclosure or kiosk panel. Connection shall be to standard of the enclosure.
- .8 Holes in enclosures, for conduit, shall be made with a knockout.
- .9 Seal with fire stop sealant all points where wiring or conduit passes through fire separations.
- .10 Flexible conduit shall only be used where flexibility is required for future equipment changes or small equipment movement.

3.02 Rigid Steel Conduit to PVC Conduit Adaptor

- .1 Provide PVC female adapter fitting. Rigid Steel conduit shall be threaded into female adapter at points of transition.

DIVISION 16 – ELECTRICAL

SECTION 16140 – WIRING DEVICES

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PART 1 GENERAL

1.01 Related Work

- .1 Section 16100, Basic Materials and Methods.

PART 2 PRODUCTS

2.01 Pull and Junction Boxes

- .1 Provide pull and junction boxes appropriately sized where required.
- .2 Provide CSA approved, pressed steel construction, hot dip galvanized, except larger boxes may be enamelled, complete with grounding lugs, and screw-on or hinged cover and sized per Canadian Electrical Code requirements, where conduit is concealed.
- .3 Provide cast FS type boxes of same material as conduit, where conduit is surface run.
- .4 Provide labelled terminals in all control junction boxes with more than four junctions.

2.02 Outlets and Switchboxes

- .1 Relocate existing outlets to a suitable position when new equipment will interfere with convenient and practical operation.

2.03 Receptacles

- .1 Relocate existing receptacles to a suitable position when new equipment will interfere with convenient and practical operation.

2.04 Wiring Connections

- .1 Use insulated twist on type for #10 AWG and smaller conductors.
- .2 Use bolted type for #8 and larger. Use Burndy Compression fittings for connecting spade type terminals to wiring.

2.05 Cover Plates

- .1 Plates in finished areas shall be plain stainless steel, satin finished, with bevelled edges and not less than 1mm thick.

PART 3 EXECUTION

3.01 Mounting of Wiring Devices

- .1 Pull boxes and junction boxes shall have lamicoid labels as outlined in Section 16010 "Equipment Identification".
- .2 Where existing equipment locations conflict with the placement of the new MCC, relocate as appropriate. This may include receptacle, emergency light and slight relocation of the control panel.

DIVISION 16 – ELECTRICAL

SECTION 16400 – SERVICE AND DISTRIBUTION

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PART 1 GENERAL

1.01 Service - General

- .1 Existing 12.5kV overhead service (BC Hydro).
- .2 Existing 300kVA 12.5kV – 347/600V transformer (BC Hydro).
- .3 Existing 400A service entrance switch.
- .4 Existing 250kVA diesel genset and 400 amp Automatic Transfer Switch

1.02 Approved Manufacturers

- .1 All distribution equipment shall be of one approve manufacturer.

Approved manufacturers are:

- Cutler Hammer
- Schneider
- Square D
- Siemens
- Pre-Approved Equal

PART 2 PRODUCTS

2.01 Main Distribution - General

- .1 Existing metering cabinet shall be left as is.
- .2 Existing 250kVA 600V Generator and controller shall be left as is.
- .3 Existing Thomson Technology TS870 automatic transfer switch with MEC310 shall be left as is.

2.02 Secondary Duct

- .1 See section 16100.

2.03 Splitters

- .1 Existing splitter shall be left as is.

2.04 Panels

- .1 Provide surface or flush mounted 500 mm wide panelboards, complete with circuit breakers with characteristics as noted on panel schedules.
- .2 Panels shall be complete with main breakers as noted on panel schedules.
- .3 Acceptable Panel manufacturers are: Cutler Hammer
 Federal Pioneer Electric
 Square D
- .4 Breakers shall be minimum 10,000 AIC bolt on type or stab-lock type. Breakers feeding transformers shall have instantaneous trip at 12 times breaker ratings.
- .5 Panels shall be fitted with trim, latch, lock and two keys. Mount top of trim 1700 mm above finished floor.
- .6 Provide typed, as-built panel schedule inside panel door.

2.05 Circuit Breakers

- .1 Enclosed circuit breakers shall have minimum instantaneous trip of 12 times breaker rating.
- .2 Submit breaker trip curves with shop drawings.
- .3 Enclosure shall be surface mount EEMAC 1.

2.06 Fuses

- .1 Provide HRC Form 1 fuses on all feeder circuits.
- .2 Provide HRC Form 2 fuses on all motor circuits.
- .3 Provide dual element fuses on all transformer feeder circuits.

2.07 Transformers

- .1 Transformers installed indoors in non-hazardous areas shall be Hammond Type F (single phase) and Type K (three phase) dry type air cooled of voltage and KVA rating as shown on Single Line Diagram.
- .2 Transformers shall have full capacity primary taps; 1 – 2.5% to 5 KVA, 4 – 2.5% above 5 KVA for single phase; 2 – 5% to 9 KVA, 4 – 2.5% above 9 KVA for 3 phase.

PART 3 EXECUTION

3.01 Balancing of Load

- .1 The contractor shall connect all new feeders to the panels so that the load is equally balanced on the 3 phases. Upon completion he shall submit ampere readings from all 3 phases to the Engineer for his approval.

3.02 Earthquake Restraint

- .1 Provide earthquake restraint support bracing and anchor bolt fastening to prevent horizontal movement or tipping of all service equipment.

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SECTION 16450 – GROUNDING

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PART 1 GENERAL

1.01 Scope of Work

- .1 Connect to existing system.
- .2 Ground all equipment in accordance with the Canadian Electrical Code.
- .3 Ensure any distribution and control transformer neutrals are grounded as required. Artificial neutrals and/or surge suppressors shall be grounded per manufacturer's instructions.
- .4 Ensure all metal enclosures for electrical equipment, including the genset, are bonded to ground.
- .5 Bond all cable tray, water piping, etc. to ground.
- .6 Bond new MCC to ground.

PART 2 PRODUCTS

2.01 Ground Connections

- .1 Provide Burndy Hyground compression connections, conductor to conductor, conductor to rods.
- .2 Use approved mechanical connector, conductor to equipment.

PART 3 EXECUTION

3.01 Station Electrode and Ground Pad

- .1 Ensure the existing service ground meets or exceeds current CE Code requirements, if inadequate, advise engineer. .
- .2 Provide #3/0 bare copper to MCC and variable frequency drives ground bus.
- .3 Provide #1 bare copper bonding conductor running the length of the cable tray and bonded to the following equipment:
 - ladder tray
 - metallic piping, metal stairwell, crane rails, metal ventilating ducts etc.
 - transformer secondary neutrals and enclosures
- .4 Provide #6 bare copper grounding conductor to surge suppressor.

3.02 **Connections**

- .1 Use Penetrox "E" joint compound on all connections.
- .2 Make connections with Burndy Hyground compression fittings.
- .3 Ground all non-current carrying metal parts of electrical equipment.

3.03 **Branch Circuit Grounding Conductor**

- .1 Circuits that are installed in conduit located in or below the main floor slab, or in direct buried conduit, shall have a ground conductor installed.
- .2 Where metallic conduit system is used as a grounding conductor, it shall have bonding jumpers where required and shall be continuously conductive.

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SECTION 16900 – CONTROLS AND INSTRUMENTATION

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PART 1 GENERAL

1.01 General Requirements

- .1 The control system is generally existing and where additions to the remote control system is required those revisions will be completed by DFO staff. Where existing equipment is reconnected to the MCC, ensure the controls remain intact and functionality remains the same. VFD local controls shall be integral to the MCC,.
- .2 Unless specifically stated otherwise, all equipment covered by this specification shall be suitable for operation in buildings or enclosures where minimum and maximum ambient temperatures are expected to be between 10°C and 40°C respectively.
- .3 Provide, except where otherwise specified, the materials of construction necessary for satisfactory operation on the service specified. Any changes from specified materials must be approved in writing.
- .4 All instruments shall be factory calibrated to values stated in the documents, or as determined from process requirements.
- .5 All instruments and devices on panel fronts and all devices in the panel rear shall be identified by a legend plate or nameplate.
- .6 Finish shall be manufacturer's standard, but must include a prime coat and two finish coats.
- .7 All process equipment packages which include control devices must provide interconnection and termination systems between all devices and equipments of the vendor's supply. This shall include, but not be limited to interconnecting tubing, piping and fittings, and terminal strips for field connections, bulkhead plates for cable and piping terminations, any local controls, block or isolation valves and all other control accessories as would normally be required on such an installation. Such installations must comply with applicable codes of good practice to ensure sound, reliable operation when installed. The supplier shall provide detailed installation instructions to the Contractor. This shall include wiring drawings and mechanical drawings showing equipment installation in pipe.
- .8 The Contractor shall provide complete sets of internal and external wiring diagrams, trouble-shooting data and calibration manuals for each device supplied.
- .10 All instruments requiring AC power supply shall be for 120 volts, 1 phase, 60 hertz.

1.02 Standards

- .1 Equipment shall be CSA approved where standards have been established by that agency.

PART 2 PARTS

2.01 Control Panel

- .1 The control panel is existing.

PART 3 EXECUTION

3.01 Control Panel

- .1 Existing control panel shall be relocated as necessary to accommodate new equipment.
- .2 Any modifications to the control panel will be performed by DFO staff.

3.02 Level Sensors

- .1 Existing level sensors shall remain as is. The scope of this contract is not expected to affect their operation.

3.03 Motor RTDs and Heaters

- .1 Existing RTDs and Heaters are to be connected to their respective VFD enclosures as required. Control of heaters shall be integral to VFD operation.

DIVISION 16 – ELECTRICAL

SECTION 16920 – MOTOR CONTROL CENTRES

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1.04 System Characteristics

- .1 347/600 volts, 3 phase, 4 wire, 60 hertz.
- .2 System solidly grounded at transformer wye neutral.
- .3 Maximum available short circuit current – 12.5 kA.

1.05 Operating Characteristics

- .1 Location: Robertson Creek Hatchery, near Port Alberni, BC
- .2 Elevation: 100 meters above sea level.
- .3 Atmosphere: Clean, occasionally damp air.
- .4 Maximum Temperature: 40 degrees C.
- .5 Minimum Temperature: 10 degrees C.

1.06 Drawings

- .1 The MCC shall be constructed in accordance with the Single Line Diagram, Layout and Control Schematics.
- .2 The Contractor shall co-ordinate any minor control wiring changes necessitated by information received from their and other equipment suppliers after closing of bids. These changes shall be made at no cost to the Owner.

1.07 Tests

- .1 The following test shall be performed by the MCC manufacturer prior to shipment:
 - a) Continuity to verify connections.
 - b) High Pot or Dielectric tests.
 - i) Each phase and ground bus with all neutrals and control circuit grounded and all contacts closed.
 - ii) Each control circuit and neutral and the ground bus with the neutral disconnected from ground, all phases grounded, and all contacts closed.

- e) The summation of all the enclosures shall fit inside the 3238mm horizontal allotted space. The existing control panel can be moved a very small amount to accommodate deviations.

2.03 Metering and Instruments

- .1 Supply metering as indicated on Single Line Diagram.
- .2 Power Monitor to be ACCUVIM IIR, IQ 260 with Transducer (Eaton) or equivalent.

2.04 Nameplates, Labels

- .1 Each unit shall have its own lamicaid service nameplate, white with engraved black lettering, 5mm high. Wording shall be per approved shop drawing.
- .2 Each MCC shall have a similar main nameplate, except with lettering 10mm high.
- .3 Overload reset button shall be identified with lamicaid nameplate.
- .4 Internal components in relay panels shall be identified with lamicaid nameplates.
- .5 Refer to Section 16010, Nameplates and Identification.

2.05 Starters

- .1 All starter components must be co-ordinated for the full range of current values from normal running loads to maximum available fault current.
- .2 Starters shall be combination type with circuit breakers with 22,000 amp RMS asymmetrical interrupting capacity, with, magnetic only trip.
- .3 The external operating handle of the circuit breaker shall be interlocked with the door, so that the handle must be in the off position before the door can be opened. There shall be a facility for padlocking this handle in the open position with up to three padlocks. It shall not be possible to close the disconnect by any means, if the disconnect handle is locked open. When the disconnect is closed, it shall be possible, using a semi secret defeater screw mechanism, to open the starter door, for testing purposes.

- .4 Starters shall have thermal or electronic overload relay.
 - a) With elements on three phases
 - b) Which has an N.O./N.C. alarm contact
 - c) Which is ambient compensated
 - d) Which is manual reset.
- .5 Starters shall have 120 volt coils.
- .6 Starters shall be connected to the vertical bus by means of stab connectors plated with the same material as the bus.
- .7 Control power circuit shall be from individual control transformers in each starter complete with two primary and one secondary fuse.
 - a) Sized for all components connected plus 100% capacity for future devices.
 - b) Grounded.

2.06 Variable Frequency Drives

- .1 All VFD components must be co-ordinated for the connected motor load.
 - a) 3 vertical turbine pumps at 75hp, 600VAC, 3 phase, 1175 RPM, 405 TP Frame, Class B Insulation and 1.1 service factor.
 - b) 1 vertical turbine pump at 15hm, 600VAC, 3 phase, 1175 RPM, 284TPH Frame, Class F insulation and 1.15 service factor.
 - c) 2 submersible well pumps at 40hp, 600VAC< 3 phase, with other characteristics yet to be specified.
- .2 Each VFD shall be mounted in the MCC in a separate section or "bucket". Each section or bucket shall have ventilation as required.
- .3 Provide 3% line reactors and load dV/dT filters as indicated, unless otherwise recommended by the manufacturers and approved by the engineer.
- .4 Provide electronic internal overload protection.
- .5 Door mount display and keypad.
- .6 Every VFD shall be capable of communication and control via EthernNet/IP

- .4 The summation of all the enclosures shall fit inside the 3238mm horizontal allotted space. The existing control panel can be moved a very small amount to accommodate deviations.

2.09 Spare Parts

- .1 Provide one standard box of spare fuses of each size in MCC
- .2 Provide one set of spare contacts for each starter size in MCC
- .3 Provide 12 spare pilot light bulbs.

PART 3 EXECUTION

3.01 Execution

- .1 The MCC shall be manufactured and delivered to site by early March 2017 and fully commissioned by April 14th, 2017.
- .2 Shall be per manufacturer's instruction.
- .3 Test and mark phase rotation prior to disconnecting the existing MCC. Confirm phase rotation of each motor when reconnected to the MCC.

3.02 Shop Drawings

- .1 Six (6) hard copies or one pdf copy of shop drawings are required for approval.
- .2 Shop drawings shall show layout and typical sections of MCC, all overall dimensions and all mounting dimensions.
- .3 Shop drawings shall include a tabulation of each unit giving nameplate engraving, breaker sizes, contactor and overload relay rating, breaker and overload trip adjustment ranges.
- .4 Contractor shall check MCC layout to insure proper location of in slab conduits, cable trenches, cable tray, etc.

3.03 Earthquake Restraint

- .1 Provide earthquake restraint bracing and anchor bolt fastening to prevent horizontal movement or tipping of all MCC's.

3.04 VFD Startup Services

- .1 The Contractor shall provide as a separate line item (a broken out price) which shall be included in the total Contract price; an allowance to have a qualified technician attend site for 2 full days to assist during startup and commissioning of the 6 VFDs. This shall include for all travel and during out allowances.
- .2 The technician shall, prior to arrival on site provide a basic list of parameters that he will need DFO input on to appropriately set the operating parameters of the VFD.
- .3 The technician shall provide basic operator training while on site to 1 or 2 operators.