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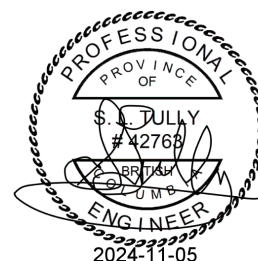
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List of Specifications

Section Number	Name	Company
Division 16	Electrical	
Section 16010	General Provisions	KWL
Section 16202	Transfer Switch	KWL
Section 16225	Motor Control Centres	KWL
Section 16925	Variable Frequency Drives	KWL

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Part 1 General

1.1 References

- .1 All standards referenced in this section shall be the most recent edition.
- .2 Canadian Standards Association (CSA):
 - a. CSA 22.1, *Canadian Electrical Code* (CEC), Part 1, Safety Standard for Electrical Installations;
 - b. CSA 22.2 No 14, Industrial Control Equipment;
 - c. C22.3 No. 7, Underground systems; and
 - d. CSA Z462, Workplace electrical safety.
- .3 Electrical Contractor's Association of British Columbia *Seismic Restraint Standards Manual – Guideline for Electrical Systems*.
- .4 *BC Safety Standards Act* – Electrical Safety Regulation.
- .5 *BC Safety Standards Act* – Safety Standards General Regulation.

1.2 Definitions

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Certification agency: an organization accredited by the Standards Council of Canada under the *Standards Council of Canada Act* as an organization engaged in conformity assessment.
- .3 Certification mark: a stamp, mark, seal, label, tag, or other identification of a certification agency, certifying that the regulated product to which it is affixed or attached meets the standard that the product must meet for certification.
- .4 Certified equipment: Regulated products which meet the standards that the product must meet for certification and are identified as such by a certification mark.
- .5 Provide: Supply and install.
- .6 AFF: Above Finished Floor.
- .7 Electrical equipment: includes apparatus, conduits, plant, pipes, poles, works and any other regulated product that is used, designed, or intended for use in conjunction with the generation, transmission, supply, distribution, or use of electrical energy for any purpose.
- .8 Electrical work: regulated work in respect of electrical equipment.
- .9 Utility: a person who owns or operates equipment or facilities in BC for the generation, transmission or distribution of electricity or communication signals that are for sale.
- .10 Rough wiring: a phase of construction in which an electrical installation is fully accessible for inspection.

1.3 Worker Qualifications

- .1 Electrical work shall be performed by qualified electricians and/or by electrical apprentices supervised by qualified electricians, all skilled in the performance of electrical work. Electrical contractors shall hold a valid BC Electrical Contractor's License (ECL). Electricians employed by a licensed electrical contractor do not require an ECL.
- .2 Workers who hold a valid Technical Safety BC Class UR FSR qualification may perform the following electrical work:
 - a. Assemble, construct, install, maintain or repair and alter underground electrical conduit.
- .3 Workers who install electrical distribution equipment on behalf of an electrical utility (work that the utility deems 'underground civil' work) shall be qualified to perform the work according to the requirements of the utility. These qualifications only apply to the specific utility work and do not entitle the holder of the qualifications to perform work beyond the specific work for the utility.

1.4 Design Requirements

- .1 Operating voltages: 600V, & 120/208V.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits.

1.5 Work Included

- .1 Provide all materials and equipment required to provide electrical equipment as listed herein and as shown on the drawings.
- .2 This shall generally include work in the electrical room:
- .3 This includes, but is not limited by the generality of the following:
 - a. Service.
 - b. Metering;
 - c. Motor control center.
 - d. Automatic transfer switch.
 - e. Variable frequency drives.

1.6 Work Not Included

- .1 The following work will be done by others. The Contractor shall co-ordinate their work with the following work and co-operate where required:
 - a. Installation

1.7 Owner Supplied Equipment and Materials

- .1 The Contractor shall accept all Owner supplied equipment and materials within 48 hours of a request to do so by the Owner. The Contractor shall inspect same prior to acceptance and any loss or damage after acceptance shall be made good at no cost to the Owner.

1.8 Contract Drawings

- .1 The electrical drawings do not show accurate civil, mechanical, structural or architectural details.
- .2 Accurate dimensions and other information shall be taken from civil, mechanical, structural, and architectural drawings, or by field measurement of the buildings/structures. 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.

1.9 Shop Drawings

- .1 The Contractor shall prepare shop drawings to provide the engineer of record with information which assists in confirming that the Contractor understands the intent of the design and what the Contractor is supposed to or intends to supply, and to provide their suppliers/fabricators/manufacturers with information which assists them in providing the equipment.
- .2 The Contractor can request AutoCAD drawing files from the Engineer to use in the production of shop drawings for equipment designed by the Engineer, and where custom wiring is required in a Motor Control Centre (MCC). Where AutoCAD drawing files have been provided by the Engineer, the Contractor and/or their equipment suppliers shall delete or dispose of those drawing files once the shop drawings have been prepared. All emails where the AutoCAD drawing files have been included as attachments shall also be deleted once the shop drawings have been prepared.
- .3 Where the Engineer determines in document review that the proposed design/equipment does not meet the specification or that insufficient information is presented, the Contractor will be requested to and shall re-submit the document(s) with the additional information requested by the Engineer.
- .4 Where electrical shop drawings are submitted electronically, the document(s) shall be in Portable Document Format (PDF). The Contractor shall submit one PDF file per piece of equipment; do not submit multiple pieces of equipment in one PDF file.
- .5 Where electrical equipment is identified on the contract drawings or in these specifications with an equipment number or tag number, the shop drawings for that equipment shall be clearly marked with the number.
- .6 Products/equipment, including options and accessories, intended for supply shall be suitably highlighted in the shop drawings. Shop drawings shall only include specific information pertinent to the specific equipment being supplied; shop drawings containing superfluous information may be rejected.
- .7 Shop drawings shall include catalog 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.
- .8 Shop drawings shall include interconnection diagrams showing terminal numbers, number of conductors between components and requirements of inter-wiring conductors. This shall include any requirements for shielding, twisting of pairs, minimum and maximum resistance, capacitance, reactance, etc.
- .9 Submit breaker trip curves and fuse curves for all breakers or fuses of more than 50 Ampere rating.

- .10 The Engineer will check shop drawings. Approval of shop drawings does not relieve the Contractor from the requirement to provide equipment and functioning systems in accordance with this specification and the contract drawings.
- .11 The Contractor shall also check manufacturer's shop drawings. They shall ensure that the drawings and equipment meet the requirements of the drawings and this specification.
- .12 Copies of all shop drawings shall also be provided to the Owner for checking.
- .13 The Contractor shall provide Record Drawings with Owner supplied drawing numbers.

1.10 Operating and Maintenance (O&M) Manuals

- .1 Two (2) copies of manufacturers' maintenance instructions and operating manuals shall be supplied by the Contractor to the Engineer showing each major piece of electrical equipment and/or equipment designated by the Engineer. Instructions and manuals shall be complete with the following:
 - a. Installation, operating, and maintenance drawings including one (1) copy of all approved shop drawings.
 - b. Catalog details of all equipment installed, including schematic drawings, layouts, and maintenance data as applicable.
- .2 O&M manuals shall also contain the following:
 - a. Copy of permits and final inspection reports by the Authorities Having Jurisdiction.
 - b. List of spare parts that may be required complete with equipment supplier contact information.
 - c. Contractor's contact information.
- .3 Each printed copy shall be contained in a hard-covered binder, complete with index and tabs.
- .4 One (1) PDF file of the O&M Manual shall be emailed to the Engineer, complete with an electronically linked table of contents.
- .5 It is intended that the O&M Manuals be complete at the facility start up date except for minor revisions for parameter adjustments made during commissioning. The Contractor shall make sufficient allowance for timing and work to provide completed O&M Manuals prior to job completion. All costs to turn over the O&M Manuals as specified are the Contractor's.

1.11 Guarantee

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

Part 2 Products

2.1 Materials and Equipment

- .1 Provide new and certified equipment, free of defects and approved for electrical installations. Factory seconds will not be accepted.
- .2 All electrical equipment shall carry a CSA approval label or labels from other agencies (acceptable to Technical Safety BC) considered equivalent to CSA. Other agencies are as follows:
 - a. cUL – Underwriter Laboratories of Canada.
 - b. ITS – Intertek Testing Services NA Ltd., (ITS - Canadian Divisions) formerly Warnock Hersey Professional Services Ltd. (label is still a stylized WH).
 - c. ETL – Intertek Testing Services NA Inc., (ITS - US Division) formerly ETL Testing Laboratories (label is still ETL).
 - d. cUL – Underwriters Laboratories Inc.
 - e. cMET – MET Laboratories Inc.
- .3 Control Panels: the above-mentioned certification marks (labels) shall be affixed to the various pieces of equipment and components within a control panel, and the complete control panel assembly shall also have a certification mark.

If certification marks are missing the Contractor shall arrange for certification by an organization acceptable to Technical Safety BC. All costs associated with the certification shall be paid by the Contractor.
- .4 Install all materials and equipment in accordance with the manufacturer's recommendations.
- .5 All equipment and systems shall meet WorkSafe BC (WSBC) requirements.
- .6 Provide WHMIS data sheets on all equipment and material, where required by WSBC.

2.2 Names of Suppliers, Manufacturers & Distributors

- .1 The Contractor shall provide, with their 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. Service Entrance & Distribution Equipment.
 - b. Conduit & Support Hardware.
 - c. Motor Control Centres & Motor Starters.
 - d. Switches & Wiring Devices.
 - e. Instrumentation Equipment.
 - f. Transfer Switches.
- .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

3.1 Equipment Identification

- .1 All electrical equipment shall be clearly identified with lamicoid labels. Tape labels are not acceptable.
- .2 Label and tag names shall be as indicated on the drawings.
- .3 Lamicoid identification labels shall have minimum 3 mm white letters on a black background. Submit list for approval with shop drawings.
- .4 Lamicoid identification labels installed on control panel doors, MCC starter doors or similar enclosure doors shall be mechanically fastened to the door(s) with stainless steel self-tapping screws.
- .5 Lamicoid identification labels for equipment mounted inside control panels, MCC starters or similar enclosures shall not be directly installed on the electrical equipment; rather, they should be installed beside or above the equipment and be fastened to the enclosure back-pan.
- .6 Ensure manufacturer's nameplates, certification labels and identification nameplates are visible and legible after equipment is installed.

3.2 Supplier Responsibilities

- .1 The Contractor shall be responsible for ensuring that all their 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 their suppliers as follows:
 - a. All suppliers shall ensure their equipment and material is suitable for the installation intended. If their 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 ensure when applying for 'equal' status to specified equipment, that their equipment is truly equal. If their 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.

3.3 Seismic Restraint

- .1 Provide seismic restraint for electrical equipment as detailed in the Electrical Contractors' Association of British Columbia *Seismic Restraint Standards Manual – Guidelines for Electrical Systems*. Where the guidelines do not provide detail for specific equipment, obtain seismic restraint details from a Professional Engineer registered in British Columbia who specializes in such designs. The Contractor shall provide and install the engineered seismic restraint system as designed, and the aforementioned Engineer shall provide Schedules S-B and S-C to the Engineer of Record at project completion to demonstrate compliance.

3.4 Alternatives

- .1 Bidders are encouraged to make alternative proposals where they consider them to be advantageous to the Owner.

Revision History

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End of Section



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Part 1 General

1.1 Standards

- .1 All standards referenced in this section shall be the most recent edition.
- .2 CSA C22.2 No.178 - Automatic Transfer Switches.
- .3 NEMA No. ICS 10 - Industrial Control and Systems AC Transfer Switch Equipment.

1.2 Scope of Work

- .1 Supply automatic transfer switch and connecting power and control cables.
- .2 This Specification covers the supply of a complete and operational automatic transfer switch equipment rated 800 Amps, 600 Volts, 3 Phase, and 60 Hz, 3 Pole, for installation by others.

1.3 Functional Requirements

- .1 General Description:
 - a. The automatic transfer switch shall automatically transfer the facility load to the generator supply in the event of a utility supply failure and return the load to the utility supply upon restoration of power. The automatic transfer switch power switching devices shall be mechanically and electrically interlocked to prevent the utility and generator supplies from being interconnected.
- .2 Automatic Sequence of Operation:
 - a. When the voltage on any phase of the utility supply is below preset levels of rated voltage for a preset time delay, a contact shall close to initiate starting of the generator set.
 - b. The load shall transfer to the generator supply when the generator voltage and frequency have reached acceptable preset levels, and the warm-up time delay has expired.
 - c. When the utility supply is restored to the above-mentioned preset levels of rated voltage on all phases, load transfer from generator to utility supply shall be initiated following expiry of the utility return timer.
 - d. Once the transfer mechanism operates and opens the generator power switching device, the transfer mechanism shall stop in the neutral position (i.e., with both power switching devices open) for the duration of the neutral delay timer setting to allow load voltage to decay prior to re-connecting the utility supply.
 - e. The load shall be re-connected to the utility supply once the neutral delay timer expires, and the transfer mechanism continues operation and closes the utility power switching device.
 - f. The load shall immediately retransfer to the utility supply (if within acceptable time limits) should the generator supply fail prior to expiry of the utility transfer delay.
 - g. The generator set shall continue to operate following a load transfer for a cooldown delay period, then a contact shall open to stop the generator set.

1.4 Shop Drawings

- .1 Refer to Section 16010.
- .2 The following shop drawings shall be submitted to the Engineer for review:
 - a. Physical Layout Drawings:
 - Outline dimensions, cable entry/exit locations, interior/exterior component layouts, connection data.
 - b. Electrical Schematic:
 - Internal wiring, customer connection terminals, optional components, controller settings.
 - c. Product Data Sheets:
 - Equipment ratings.

Part 2 Products

2.1 General

- .1 The transfer switch shall be manufactured in accordance with this specification and applicable standards.
- .2 Supplier shall be responsible for ensuring the compatibility of all components of the transfer switch.
- .3 The transfer switch shall be free of defects in material and workmanship.

2.2 Automatic Transfer Switch

- .1 Transfer Switch must be acceptable to BC Hydro.
- .2 The transfer switch shall be comprised of three switching poles and an unswitched neutral.
- .3 The automatic transfer switch assembly shall be rated for 100% continuous load without de-rating. The current rating shall be based on all classes of load including resistive, and motor loads.
- .4 Fault withstand current rating of the complete assembly shall be minimum 35kA RMS. The interrupting and closing rating shall be equal to or exceed the required withstand rating. This rating shall be obtained with standard upstream over current protection devices.
- .5 The automatic transfer switch must be listed or certified to the following safety standards:
 - a. CSA-C22.2 No. 178 Automatic Transfer Switches.
- .6 The complete assembly shall be mounted in MCC1.
- .7 All materials and parts used in the unit shall be new, of current manufacture, of best industrial grade, and free from defects and imperfections.
- .8 The transfer switch mechanism shall provide a simple means of manual operation using only components, which are permanently affixed, in the operating position.
- .9 The unit shall permit manual operation of the transfer switch while the system is energized and carrying rated load.

- .10 All internal control devices used in the automatic transfer switch shall be cable of being de-energized and isolated from the system by use of an accessible isolation plug for servicing procedures as required.
- .11 The automatic transfer switch design shall provide front accessible components and wiring for easy serviceability. Power or control connections, which are not readily serviceable while the transfer switch is mounted in its enclosure, are not acceptable.

2.3 Standard Control Features

- .1 Transfer switch control power must be obtained from the source being transferred to. The controls shall not require any connection to external power sources. Transfer switches requiring power from the engine starting (or other) battery are not acceptable.
- .2 A control circuit isolation plug shall be provided to isolate all control circuitry inside the transfer switch to facilitate maintenance procedures. When isolated, there shall be no voltage present on the control circuitry.
- .3 The transfer switch controller shall be microprocessor based and shall contain all voltage/frequency sensing and timing functions.
- .4 All programming set-points for voltage, frequency and time delays shall be software programmable from the front panel mounted keypad, and all parameters shall be displayed in alpha numeric format.
- .5 The transfer switch controller shall include an operator interface liquid crystal display (LCD) which is door mounted. The LCD shall have an automatic scrolling display feature for all main system information. The following information shall be displayed:
 - a. System Time.
 - b. Transfer switch position.
 - c. Utility supply metering – 3 phase voltage and frequency.
 - d. Generator supply metering – 3 phase voltage and frequency.
 - e. Timer countdown display.
 - f. Test mode operation indication.
 - g. Data Logging of events.
- .6 Digital metering provided by the transfer switch controller shall have an accuracy of $\pm 1\%$ for all voltage and frequency readings. Frequency shall be displayed to at least one decimal. Three phase line to line voltages shall be displayed for both generator and utility supplies.
- .7 The transfer controller shall provide data logging and shall store the data in non-volatile memory. The following events shall be recorded:
 - a. Total Number of Transfers.
 - b. Total Number of Transfers due to source failure.
 - c. Number of Hours Controller is energized.
 - d. Number of Hours Load is on Utility.
 - e. Number of Hours Load is on Generator.
 - f. Utility or Generator Voltage/Frequency Data at time of fault.

- .8 Three phase under voltage sensing shall be provided for the utility supply. The under-voltage sensor shall be user adjustable from 70 to 95% of nominal and shall be based on a falling (i.e., drop-out) voltage. The under-voltage sensor shall be factory set at 85% nominal voltage. The under-voltage sensor shall reset (i.e., pick-up) 5% above the dropout setting. The under-voltage sensor shall include a transient time delay feature set at 1 second.
- .9 Three phase under voltage sensing shall be provided for the generator supply. The under-voltage sensor shall be user adjustable from 70 to 95% of nominal and shall be based on a falling (i.e., drop-out) voltage. The under-voltage sensor shall be factory set at 85% nominal voltage. The under-voltage sensor shall reset (i.e. pick-up) 5% above the dropout setting. The under-voltage sensor shall include a transient time delay feature set at 5 seconds.
- .10 Under frequency sensing shall be provided for the generator supply to permit load transfer to the generator supply if within nominal limits. The frequency sensing function shall contain a user adjustable setpoint with a range of 70 to 90%. The factory setting shall be set at 90% of nominal frequency.
- .11 An engine start contact shall be provided which shall close to initiate starting of the engine. The engine start contact shall be rated 5A@120/240VAC, 5A@28VDC resistive.
- .12 The following time delay functions shall be provided:
 - a. Engine Start-A time delay on engine start shall be provided to delay the engine start signal after failure of the utility source. The time delay shall be user adjustable 0 to 60 seconds, factory set at 3 seconds.
 - b. Engine Warm-up- A time delay for engine warm-up shall be provided which permits transfer to the generator supply after generator voltage and frequency exceed acceptable limits. The time delay shall be user adjustable 0 to 60 seconds, factory set at 2 seconds.
 - c. Utility Return- A time delay for return to utility shall be provided which permits transfer to the utility supply only after stable voltage conditions exist for the specified time period. The time delay shall be user adjustable 0 to 30 minutes, factory set at 2 minutes.
 - d. Engine Cooldown- A time delay for engine cooldown shall be provided which delays the engine stop signal after load has retransferred to the utility source until the time delay period expires. The time delay shall be user adjustable 0 to 30 minutes, factory set at 2 minutes.
 - e. Neutral Delay- A time delay for neutral position shall be provided to minimize the effect of out-of-phase transfer due to connected motor load. The time delay shall be user adjustable 0 to 60 seconds, factory set at 3 seconds.
- .13 Provision for local and remote operator-initiated system test modes shall be provided. Test modes shall allow 'on load' testing of the generator set. Control logic shall be provided for immediate transfer to the utility supply (if within acceptable limits) should the generator set fail during any activated test mode.
- .14 Control logic shall be provided for sensing a Transfer Switch Failure condition, and if the alarm condition is activated, the transfer controller shall automatically force a transfer to the alternate source if available.

- .15 LED indicator lights shall be provided to indicate the following:
 - a. load on utility status (green).
 - b. load on generator status (red).
 - c. utility source available status (green).
 - d. generator source available status (green).
- .16 The transfer controller shall provide a user-initiated timer bypass feature to allow temporary bypassing of any active timer to reduce unnecessary delays in testing or trouble shooting procedures.
- .17 Five user programmable output contacts shall be provided by the transfer controller. The contacts shall be pre-wired to customer accessible terminal blocks and shall be rated 10A, 120/240VAC, 5A, 28Vdc resistive, Form C. Each output contact shall be user programmable for one of the following control functions including:
 - a. Load on Utility.
 - b. Load on Gen.
 - c. Load Disconnect Contact.
 - d. Fail to Transfer.
 - e. Utility Power Available.
 - f. Generator Power Available.
 - g. Engine start.
 - h. ATS Not in Auto.
 - i. ATS in Auto.
 - j. Pre-transfer warning.
- .18 An automatic exercise time function shall be provided for generator testing. A 7/14/21/28-day, programmable time clock shall be provided. The timer shall be fully programmable for; day, week, time of day, duration of the test and type of test mode (i.e., On-Load or Off-Load). The exercise timer shall utilize the transfer controller's internal time clock for referencing all timing functions. The time clock shall have a 10-minute power reserve feature to retain correct time settings during short duration utility power failures. The transfer switch shall automatically re-transfer back to the utility supply if the generator set fails during an exercise period.
- .19 The Transfer controller shall contain an internal Real-time clock c/w battery back-up and daylight-savings programming functionality.

2.4 Approved Transfer Switch

- .1 Acceptable models shall be
 - a. Thomson Technology TS 870 series automatic transfer switch.
 - b. Eaton ATC3 Series.
 - c. Asco Series 300SE.
 - d. or approved equal.

Part 3 Execution

3.1 Factory Testing

- .1 The automatic transfer switch shall be factory tested prior to delivery to the purchaser. The following tests shall be conducted by qualified factory personnel:
 - a. Visual Inspection: Electrical and Mechanical inspections to verify installed components are of correct ratings, meet the requirements of the project specifications and to ensure regulatory and quality requirements are met:
 - Calibration Label/Equipment labels Installed and Correct.
 - All safety/warning labels attached.
 - All wiring straight, neatly bundled and adequately protected.
 - All options supplied as specified.
 - Final Documentation is Enclosed (Drawings, O&M Manual).
 - b. Mechanical Tests: As a minimum, the following mechanical tests shall be performed on the transfer switch:
 - Power Conductor Torque Verification.
 - Verification of Mechanical Interlock.
 - Manual ATS Mechanism Operation/Adjustment.
 - All Mechanical Fasteners/Wire Connections Tight.
 - c. Electrical Tests: As a minimum, the following electrical tests shall be performed on the transfer switch:
 - Adjustment/Setting All Timers and Voltage Sensors.
 - Verification of Electrical Interlock.
 - Function Test-Normal Operation-3 Complete Cycles.
 - Mechanism Adjustment.
 - Dielectric Test.
- .2 The transfer switch manufacturer shall provide upon request of the project engineer, certified Factory Test Reports for the transfer switch supplied.

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Part 1 General

1.1 Related Sections

- .1 Section 16010 General Provisions.
- .2 Section 16202 Automatic Transfer Switch.

1.2 Summary

- .1 This section covers the supply, and delivery of Motor Control Centres (MCC) to control and operate various loads. The MCC shall be provided complete with breakers, motor starters, variable frequency drives and other equipment as shown on the Single Line Diagrams.

1.3 Submittals

- .1 Submittals: in accordance with Section 16010.
- .2 Manufacturer's instructions that indicate special handling criteria, installation sequence, and cleaning procedures.
- .3 Shop drawings shall include:
 - a. outline dimensions.
 - b. configuration of identified compartments.
 - c. floor anchoring method and dimensioned foundation template.
 - d. cable entry and exit locations.
 - e. dimensioned position and size of busbars and details of provision for future extension.
 - f. schematic and wiring diagrams.
- .4 Provide O&M data for MCC for incorporation into the O&M Manuals. Include data for each type and style of starter.

1.4 Standards

- .1 All standards referenced in this section shall be the most recent edition.
- .2 Each MCC shall be manufactured in accordance with CSA Standards and shall carry CSA approval number on the nameplate.
- .3 All electrical components in the MCC shall have a CSA label or equivalent. The MCC shall be constructed to CSA Standard C22.2, No. 14-18.

1.5 Manufacturer

- .1 The Contractor shall purchase the MCC from one of the following manufacturers:
 - a. Allen Bradley Canada Ltd.,
 - b. Eaton Canada, and
 - c. Schneider Electric Canada.
- .2 The Contractor shall advise the manufacturer of the installation site and operating conditions and system characteristics. They shall ensure that the MCC supplied is suitable for operation under these conditions.

1.6 System Characteristics

- .1 The equipment shall be installed indoors and shall be designed for continuous operation under the following conditions:
 - a. Ambient Temperature: 0 °C minimum to 40 °C maximum.
 - b. Altitude: 5 m above sea level.
 - c. Atmosphere: Clean.
 - d. System Voltage: 600, 3Ø, 4 W.
 - e. System Frequency: 60Hz.
- .2 System solidly grounded, wye neutral.
- .3 Available short circuit current is 35,000 Amps.

1.7 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.

1.8 Tests

- .1 The following tests shall be performed by the MCC manufacturer prior to shipment:
 - a. Continuity to verify connections.
 - b. High Pot or Dielectric tests.
 - c. Each phase and ground bus with all neutrals and control circuit grounded and all contacts closed.
 - d. Each control circuit and neutral and the ground bus with the neutral disconnected from ground, all phases grounded, and all contacts closed.
 - e. One certified copy of the results of these tests shall accompany the MCC when it is shipped to the site.
 - f. One certified copy of the results of these tests shall be emailed to the Engineer at the time of shipment.
- .2 Allow for one (1) day of inspection/shop test of equipment by the Engineer prior to shipping the MCC. Attendance at the shop test is at the discretion of the Engineer and may be declined.
- .3 Inform the Engineer of the dates available for the shop test at least two weeks in advance to allow scheduling. The Engineer will inform the Contractor at this time if the shop test will be attended.

Part 2 Products

2.1 General Construction

- .1 The MCC shall have a NEMA1, general purpose enclosure.
- .2 The MCC shall be front mounted and have floor mounting channel and lifting angles.
- .3 Sections shall be complete with continuous vertical wireway.
- .4 Buswork shall be tin plated aluminum.
- .5 Vertical bus shall be rated at 300 A minimum.
- .6 Horizontal bus shall be rated minimum 800 A, with provision for extension to the left.
- .7 Bus bracing shall withstand 42,000 A RMS symmetrical short circuit current unless specified otherwise.
- .8 Vertical sections shall be:
 - a. 500 mm deep.
 - b. 500 mm wide unless specified otherwise.
 - c. 2,325 mm high.
- .9 Each MCC shall consist of one or more modular vertical sections bolted together to form a rigid, free-standing, dead-front assembly, and shall be designed as to permit future additions or changes of individual units and extensions to the MCC by the user. MCCs shall be complete assemblies, with components, units and wiring as specified herein.
- .10 Units mounted in front of board only. MCCs will be installed against a wall and there will be no access to the rear.
- .11 Wiring shall be NEMA Class IISB (custom drawings required).
- .12 All bus connections shall be front accessible for servicing.
- .13 Provide a 6 mm x 50 mm horizontal copper ground bus running the length of the MCC. Provide lugs for connecting cables/conductors.
- .14 All units, except those too heavy or bulky to manipulate, shall be plug-in.
- .15 Each unit shall be automatically connected through a grounding finger to a vertical ground bus as it is inserted.
- .16 The MCC shall be painted ASA Grey 61.
- .17 Individual compartments shall be barriered to minimize the possibility of ionization occurring within a compartment spreading to other compartments.
- .18 There shall be provision for top and bottom entry of cables and conduit and there shall be entry plate for bottom of each section.
- .19 Control wires shall be tagged/numbered at both ends in accordance with the drawings.
- .20 Plastic tubular wire markers shall be used throughout.
- .21 Control wiring terminals shall be marked in accordance with the drawings.
- .22 Pushbuttons, pilot lights and selector switches etc., shall be heavy duty oiltight. They shall be identified with lamicoid nameplates.

2.2 Detailed Description PDC-001

- .1 The Motor Control Centre shall contain the following:
 - a. One incoming section, 762 mm wide minimum complete with main lugs for 4 #500 MCM copper conductor.
 - b. Main breaker compartment.
 - c. Revenue metering compartment.
 - d. Automatic transfer switch.
 - e. PDC-001 bus bracing shall withstand 45,000 A RMS symmetrical minimum.

2.3 Main Breaker

- .1 Main breaker shall be 800A, LSIG electronic trip type:
 - a. Moulded case breaker.
 - b. Interrupting rating of 45,000 amp RMS symmetrical minimum.
 - c. Rated for service entry to BC Hydro standards.

2.4 Metering and Instruments

- .1 Supply metering as indicated on the Single Line Diagram, including meters, selector switches, instrument transformers and fusing. Instruments shall be flush (semi-flush) mounting, and similar types shall have matching faces.
- .2 Provide kilowatt hour meter: 3 phase, 4 wire, 3 element, with resettable 15-minute thermal demand indicator; semi-drawout construction case.
- .3 Provide instrument transformers as required, metering class accuracy, with adequate capacity for meters connected plus 50% for future additions.

2.5 Automatic Transfer switch

- .1 Refer to Section 16202.

2.6 Detailed Description MCC-001

- .1 The Motor Control Centre shall contain the following:
 - a. Feeder breakers as indicated on the Single Line Diagram.
 - b. Variable frequency drives as indicated on the Single Line Diagram.

2.7 Variable frequency drives

- .1 VFDs shall be have the following:
 - a. Incoming fused disconnect or circuit breaker, interlocked with door handle.
 - b. VFD cubicle shall have an incoming fused disconnect or circuit breaker with 35,000 amp RMS symmetrical minimum interrupting capacity with thermal magnetic trip, interlocked with the door handle.
 - c. Door mounted human interface module (HIM).
 - d. Ethernet I/P based control with door mounted human interface module.
 - e. Door mounted indication lights.
 - f. Minimum 3% line impedance input filter.

- g. Low voltage transformer, 120 Vac.
 - h. Low voltage power supply (24 Vdc).
 - i. Required accessories such as fans, panduit, terminals blocks, and fuses.
 - j. Electrical isolation from power circuits for all low voltage logic and control circuits.
 - k. Start / stop pushbuttons.
 - l. Local / Remote switch.
 - m. Green "RUNNING" pilot light.
 - n. Red "OFF" pilot light.
 - o. Yellow "Fault indication" pilot light.
- .2 Approved manufacturers are:
- a. Allen-Bradley Powerflex 753 series;
 - b. Schneider Altivar ATV900 series, and
 - c. Eaton PowerXL DG1.

2.8 Nameplates, Labels

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

2.9 VFD Cubicles

- .1 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. 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.

2.10 Feeder Cubicles

- .1 The feeder cubicle components must be co-ordinated for the full range of current values from normal running loads to maximum available fault current.
- .2 Feeder cubicles shall contain circuit breakers with minimum 35,000 A RMS symmetrical interrupting capacity with thermal magnetic 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. 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.

2.11 Spare Parts

- .1 Provide one standard box of spare fuses of each size in MCC.

- .2 Provide one spare 300 volt 4 pole convertible contact control relay.
- .3 Provide six (6) spare pilot light bulbs.

2.12 Alternatives

- .1 Supplier may propose combining PDC-001 and MCC-001 into one structure as an alternative. Refer to layout drawing for restrictions.
- .2 Supplier may propose separating PDC-001 into stand-alone structures for service entry with metering, main breaker and automatic transfer switch.

Part 3 Execution

3.1 Field Quality Control

- .1 Perform tests in accordance with Section 16010.
- .2 Ensure moving and working parts are lubricated where required.
- .3 Test starters and VFDs to prove satisfactory performance of the MCC.

3.2 Earthquake Restraint

- .1 Provide seismic restraint for electrical equipment as detailed in the Electrical Contractors' Association of British Columbia *Seismic Restraint Standards Manual – Guidelines for Electrical Systems*. Where the guidelines do not provide detail for specific equipment, obtain seismic restraint details from a Professional Engineer registered in British Columbia who specializes in such designs. The Contractor shall provide and install the engineered seismic restraint system as designed, and the aforementioned Engineer shall provide Schedules S-B and S-C to the Engineer of Record at project completion to demonstrate compliance.
 - a. Provide earthquake restraint bracing and anchor bolt fastening to prevent horizontal movement or tipping of all MCCs.

Revision History

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Part 1 General

1.1 Scope of Work

- .1 The Regional District of Nanaimo, hereinafter referred to as 'the District' is upgrading the Wellington Pump Station. The scope of this contract for the supply of Variable Frequency drives (VFDs) is outlined below.
- .2 Supply and delivery of four (4) cabinet mounted VFDs complete with the following:
 - a. Enclosure complete with 100 mm (4") plinth.
 - b. 130 hp normal duty VFD.
 - c. Incoming fused disconnect or circuit breaker, interlocked with door handle.
 - d. Door mounted human interface module (HIM).
 - e. Ethernet I/P based control.
 - f. Door mounted indication lights.
 - g. Minimum 3% line impedance input filter.
 - h. Low voltage transformer.
 - i. Low voltage power supply (24 Vdc).
 - j. Required accessories such as fans, panduit, terminals blocks, and fuses;
- .3 Non-witness factory tests.

1.2 Related Sections

- .1 Section 16010 General Provisions.

1.3 Standards

- .1 Equipment shall be built to applicable CSA standards.
- .2 Equipment shall carry a CSA or equivalent agency label. Refer to Section 16010.

1.4 System Characteristics

- .1 The equipment shall be installed indoors and shall be designed for continuous operation under the following conditions:
 - a. Ambient Temperature: 0 °C minimum to 40 °C maximum.
 - b. Altitude: 5 m above sea level.
 - c. Atmosphere: Clean.
 - d. System Voltage: 600, 3Ø.
 - e. System Frequency: 60 Hz.
- .2 System solidly grounded, wye neutral.
- .3 Available short circuit current is 35,000 Amps.

1.5 Drawings

- .1 The VFDs 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.

1.6 Manufacturer's Tests

- .1 The VFDs shall receive standard shop tests performed to ensure the quality of the product. Shop tests shall include full energization, and measurement/setting of all required operating parameters.
- .2 The Contractor shall forward one certified copy of the test results to the Owner and one certified copy to the Engineer.

1.7 Approved Manufacturers

- .1 VFDs shall be constructed by approved manufacturers. Approved manufacturers are as follows:
 - a. Allen-Bradley Powerflex 753;
 - b. Schneider Altivar ATV900; and
 - c. Eaton PowerXL DG1.

1.8 Shop Drawings

- .1 Prior to manufacture the successful bidders shall submit shop drawings per Section 16010 for approval.
 - a. General arrangement drawing complete with dimensions and weights.
 - b. Nameplate drawing.
 - c. Power and control wiring diagrams.
 - d. Bulletins on all accessories, meters, relays, etc.

1.9 Manuals

- .1 The Contractor shall provide an electronic copy (PDF) of manuals and two sets of hardcopy manuals with the VFDs. The manuals shall contain:
 - a. complete instructions on handling, receiving, connection and commissioning.
 - b. as built copies of all drawings.
 - c. certified copies of all factory tests.
 - d. recommended operating and maintenance procedures.
 - e. copies of warranties.
 - f. bulletins for all accessories, meters, relays, etc.

Part 2 Products

2.1 Enclosure mounted VFDs

- .1 Enclosure:
 - a. NEMA1.
 - b. All steel shall be degreased, primed with a minimum two coats, and painted with a minimum two coats of high gloss enamel. Equipment mounting pans shall be white, all other surfaces ASA 61 grey.
 - c. Maximum enclosure dimensions to be 1000 mm x 600 mm, refer to layout drawing.
 - d. Cable entry shall be through centred 250 mm x 250 mm-wide openings, top and bottom.
 - e. Incoming connection shall be at the top of the enclosure.
 - f. Provide non-metallic or aluminum gland plate for termination of single conductor Teck armoured cable.
 - g. Outgoing feeders shall exit at the bottom of the enclosure.
 - h. Electrical isolation from power circuits for all low voltage logic and control circuits.
 - i. Start / stop pushbuttons.
 - j. Local / Remote switch.
 - k. Green "RUNNING" pilot light.
 - l. Red "OFF" pilot light.
 - m. Yellow "Fault indication" pilot light.
- .2 Wiring:
 - a. Control wiring shall be stranded TEW or extra flexible switchboard type, labelled with tubular markers at both ends.
 - b. Terminals shall be labelled with numbers matching the wire markers and wiring diagrams.
- .3 Labels:
 - a. All components shall be clearly labelled. Provide lamicaid labels, white on black, on the exterior door.
 - b. Internal components may be labelled with lamicaid nameplates, plastic or metal tags. Tape labels will not be accepted.

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