TENDER DOCUMENTS

SUBSECTION 6.54
ELECTRICAL POWER DISTRIBUTION

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SUBSECTION 6.54 ELECTRICAL POWER DISTRIBUTION

6.54.1 GENERAL

6.54.1.1 This subsection sets out the requirements related to electrical power distribution work under this Contract.

6.54.1.2 Any specific requirements related to the supply and installation of electrical power distribution equipment under this Contract are set out in Section 4 *Special Technical Conditions* and on the drawings.

6.54.1.3 The requirements related to the supply and installation of electrical cables are set out in subsection 6.52 *Electrical Cables*.

6.54.2 REFERENCE STANDARDS

6.54.2.1 The **Contractor** shall perform all power distribution work in accordance with the requirements of the following standards and documents to which the provisions of the Contract are added:

6.54.2.1.1 (ACNOR(CSA)) Canadian Standards Association

- CAN/CSA-C22.2 NO. 0-M91 (R2006*) General Requirements – Canadian Electrical Code, Part II;*
- CAN/CSA-C22.2 NO. 0.4-04 *Bonding of Electrical Equipment;*
- CAN/CSA-C22.2 NO. 4-04 *Enclosed and Dead-Front Switches (Tri-National standard, with ANCE NMX-J-162 and UL 98)*;
- CAN/CSA-C22.2 NO. 5-02 (R2007) *Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-National standard, with UL 489 and NMX-J-266-ANCE);*
- CAN/CSA-C22.2 NO. 14-05 *Industrial Control Equipment;*
- CAN/CSA-C22.2 NO. 29-M1989 (R2004) *Panelboards and Enclosed Panelboards;*
- CAN/CSA C22.2 NO. 39-M1987 (R2007) *Fuseholder Assemblies;*
- CAN/CSA C22.2 NO. 41-07 *Grounding and Bonding Equipment (Bi-National Standard with UL467);*
- CAN/CSA C22.2 NO. 106-05 *HRC-Miscellaneous Fuses;*

- CAN/CSA C22.10-07 *Quebec Construction Code - Chapter V, Electricity - Canadian Electrical Code, Part I (Twentieth Edition) with Quebec Amendments*;

- CAN3-C235-83 (R2006) *Preferred Voltage Levels for AC Systems, 0 to 50 000 V.*

6.54.2.1.2 (IEEE) Institute of Electrical and Electronic Engineers

- IEEE 837-2002 *IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding*.

6.54.2.1.3 (MTQ) Ministère des Transports du Québec

- MTQ – *Cahier des charges et devis généraux (CCDG)*.

6.54.3 MATERIALS

6.54.3.1 GENERAL

6.54.3.1.1 All distribution equipment shall be CSA approved.

6.54.3.1.2 All materials, electrical devices and control and distribution devices shall operate at a frequency of 60 Hz and within the limits set out in standard CAN3-C235.

6.54.3.1.3 Control boards and components shall be factory assembled.

6.54.3.2 GROUNDING MATERIALS AND EQUIPMENT

6.54.3.2.1 Grounding materials and equipment shall conform to standards CAN/CSA C22.2 NO. 0.4 and CAN/CSA C22.2 NO. 41.

6.54.3.2.2 Grounding materials and equipment shall be compatible with one another and shall meet the following requirements:

6.54.3.2.2.1 rod electrodes shall be copper-clad steel and shall be 3 m long and 19 mm in diameter;

6.54.3.2.2.2 bare grounding conductors shall comprise twisted copper wires annealed after being drawn and of the gauge specified on the drawings and in the *Special Technical Conditions*;

6.54.3.2.2.3 insulated grounding conductors shall be RW90 and shall be green;

6.54.3.2.2.4 accessories such as conduit bushings, flanges, connectors and straps required to complete the grounding system shall be of the type and size specified on the drawings and in the *Special Technical Conditions*.

6.54.3.2.3 Grounding materials and equipment shall be manufactured by Robuste or Caldweld or other manufacturers of approved equivalent products.

6.54.3.3 FUSED AND NON-FUSED SWITCHES

6.54.3.3.1 Switches and switch boxes shall conform to standards CAN/CSA-C22.2 NO. 0, CAN/CSA-C22.2 NO. 4 and CAN/CSA C22.10. If the switch is installed in a single-use outdoor box, it must be CSA-certified type 4X.

6.54.3.3.2 All switches required for this Contract shall be supplied by the same manufacturer and shall meet the requirements set out on the drawings and in the *Special Technical Conditions.*

6.54.3.3.3 Switch boxes shall be stainless steel.

6.54.3.3.4 Switches shall be capable of being locked in the “closed” or “open” position.

6.54.3.3.5 If the switch is installed in a single-use outdoor box, it shall have a door with a tamper-proof mechanical latch that prevents the box from being opened when the level is in the “closed” position.

6.54.3.3.6 The fuseholders for each switch shall be appropriate to the fuse rating prescribed on the drawings and shall conform to standard CAN/CSA C22.2 NO. 39.

6.54.3.3.6.1 No adapter shall be used with fuseholders.

6.54.3.3.7 Switches shall be equipped with a solid four (4) wire, three (3) phase, 347/600 V neutral.

6.54.3.4 MOLDED-CASE BREAKERS

6.54.3.4.1 Molded-case breakers shall conform to standard CAN/CSA-C22.2 NO. 5; they shall be manual and automatic quick-close and snap switches with compensation for an air temperature of 40°C.

6.54.3.4.2 The breaker lugs shall be separated by a protective wall and shall be capable of accepting 8 to 1/0 gauge single-strand wires.

6.54.3.4.3 The breaker insulation resistance shall be 10,000 megohms at a continuous current of 5,000 V.

6.54.3.4.4 Breakers shall be equipped with an insulating plate and bolts for attaching bus bars.

6.54.3.4.5 On multipole circuits, common-trip breakers shall have a single arm.

6.54.3.4.6 Breakers with magnetic snap devices shall be designed to activate only when the current reaches the setting. The setting for breakers shall be three (3) to eight (8) times the nominal current.

6.54.3.5 FUSES

6.54.3.5.1 Fuses shall be size I-J (formerly class J) high rupturing capacity (HRC) fuses conforming to standard C22.2 NO.106 and the requirements of the drawings and the *Special Technical Conditions.*

6.54.3.5.2 All fuses supplied under this Contract shall come from the same manufacturer.

6.54.3.6 CONTACTORS

6.54.3.6.1 Contactors shall conform to standards CAN/CSA-C22.2 NO. 14 and CAN/CSA-C22.2 NO. 29 and the requirements of the drawings and the *Special Technical Conditions.*

6.54.3.6.2 Contactors shall include but shall not be limited to the following features:

6.54.3.6.2.1 be magnetic;

6.54.3.6.2.2 have three poles normally open;

6.54.3.6.2.3 be equipped with four types of contacts, including two auxiliary contacts that are normally open and two (2) auxiliary contacts that are normally closed;

6.54.3.6.2.4 carry a minimum alternating current of 90 A;

6.54.3.6.2.5 operate at a voltage of 600 V;

6.54.3.6.2.6 have a coil supply at 120 V, 60 Hz.

6.54.3.6.3 The insulation resistance of the contactors shall be 10,000 megohms at a continuous current of 5,000 V between the coil terminals.

6.54.3.6.4 The insulating part and the exposed parts of the contactors shall have been treated with an antifungal agent.

6.54.3.7 SINGLE-PHASE TRANSFORMER

6.54.3.7.1 The single-phase transformer supplying the photoelectric cell shall have a power of 350 VA, a primary voltage of 347 V and a secondary voltage of 120 V.

6.54.3.8 PHOTOELECTRIC CELL

6.54.3.8.1 The photoelectric cell shall be designed for outdoor use at 120 V and 1,500 VA.

6.54.3.8.2 A contact that is normally closed and a locking device with a twist-lock female plug are required for the photoelectric cell.

6.54.4 NOMINAL VOLTAGES

6.54.4.1 The nominal operating voltages of the new electrical circuits included in this Contract shall conform to standard CAN3-C235.

6.54.5 EXECUTION OF WORK

6.54.5.1 PLANNING

6.54.5.1.1 At least fourteen (14) days before installation of electrical components begins, the **Contractor** shall submit to the Engineer for review and comment technical data sheets for the switches, breakers, fuses, contactors, transformers and photoelectric cells, including but not limited to:

6.54.5.1.1.1 characteristic curves based on time/current constants for breakers with an allowable current of 100 A or more or a rupturing capacity of 22,000 A symmetrical or more at circuit voltage;

6.54.5.1.1.2 the characteristics for each type of fuse used, including but not limited to average fuse time at a given current, I2t (to coordinate the fuses) and allowable peak current.

6.54.5.2 GROUNDING OF PRIMARY AND SECONDARY CIRCUITS

6.54.5.2.1 The **Contractor** shall install complete, permanent and continuous primary and secondary grounding systems as indicated on the drawings and in conformity with standards CAN/CSA C22.2 NO. 41 and CAN/CSA-C22.2 NO. 0.4 and the manufacturer's instructions.

6.54.5.2.2 Splicing is not permitted.

6.54.5.2.3 A bonding conductor shall be carefully attached to the outside of rigid metal conduit and connected at each end to a coupler with a ground boss, a weldless lug, a wire tie or a cap washer and screw.

6.54.5.2.4 Primary circuits shall be grounded as follows:

6.54.5.2.4.1 connections to the grounding bars shall be made using crimp connectors on the conductor;

6.54.5.2.4.2 mechanical connectors shall be used to make connections to equipment with ground bosses;

6.54.5.2.4.3 a bare cold-drawn copper wire of a gauge indicated on the drawings shall be installed to connect the secondary circuits and dry transformers and along all distribution cable trays;

6.54.5.2.4.4 all equipment boxes, raceways and distribution boards shall be grounded;

6.54.5.2.4.5 electrical cable sheaths shall be grounded with flexible copper wire of a gauge indicated on the drawings securely soldered, not fastened by mechanical means, to the sheath.

6.54.5.2.5 The secondary circuit shall be grounded as follows:

6.54.5.2.5.1 buried connections shall be made using permanent mechanical connectors or tooled copper compression connectors controllable and conforming to standard IEEE 837;

6.54.5.2.5.2 mechanical connectors shall be used to connect devices with grounding lugs;

6.54.5.2.5.3 a separate grounding conductor shall be installed for each outdoor light fixture;

6.54.5.2.5.4 the metal armour of single-conductor cables shall be connected at one end to the power supply box and at the other end to a non-metallic entry plate.

6.54.5.3 INSTALLATION OF BREAKERS, CONTACTORS, SWITCHES AND FUSES

6.54.5.3.1 The **Contractor** shall design the layout and assembly of the electrical components on existing or new back plates in accordance with the requirements of standard CAN/CSA C22.10.

6.54.5.3.2 Breakers, contactors, switches and fuses shall be installed in power supply and distribution cabinets as indicated in the *Special Technical Conditions* and on the drawings and as directed by the Engineer.

6.54.5.3.3 Fuses shall be inserted in the fuseholders immediately before the circuit is powered on. The fuses shall be inserted in the appropriate fuseholders and shall be perfectly matched in order to protect the designated electrical circuit.

6.54.5.3.4 A label shall be affixed near every fuseholder containing information on the model and capacity of replacement fuses. The label shall conform to standard CAN/CSA-C22.2 NO. 14.

6.54.5.3.5 The **Contractor** shall install the contactors and connect the auxiliary controls.

6.54.5.3.6 Switches and contactors shall be identified by a plate measuring 20 mm by 90 mm bearing the name of the load controlled. The plate shall be made of 3 mm plastic laminate with a black surface and a white core and shall be mounted mechanically with self-tapping screws. The text to be engraved shall be at least 8 mm high.

6.54.5.4 REPLACEMENT/MAINTENANCE PARTS

6.54.5.4.1 The **Contractor** shall supply three (3) replacement/maintenance fuses for each type of fuse installed, before the Interim Certificate of Completion is issued.

6.54.5.4.2 The replacement/maintenance fuses shall be supplied in their original container. The container shall indicate the type, capacity and voltage of the fuse.

6.54.5.4.3 A list of the replacement/maintenance fuses supplied shall be submitted to the Engineer before the Interim Certificate of Completion is issued. The list shall include a description of the type, capacity and voltage of the fuses as well as a description of the circuits in which the fuses can be used.

6.54.5.5 OPERATING MANUAL

6.54.5.5.1 The **Contractor** shall submit to the Engineer for approval a manual containing operating procedures and performance specifications for the electrical systems and equipment installed under this Contract before the Interim Certificate of Completion is issued.

6.54.5.5.2 The operating procedures shall include:

6.54.5.5.2.1 diagrams of the control circuits for each system, including the climate control circuit;

6.54.5.5.2.2 a description of each system/installation and its control devices;

6.54.5.5.2.3 a description of the operation of each system/installation under various loads, with a program of set point changes and a list of seasonal variations.

6.54.5.5.3 The performance specifications shall include:

6.54.5.5.3.1 the performance data provided by the manufacturer of the installed equipment indicating the points where the equipment will be used once commissioning is complete;

6.54.5.5.3.2 any other specific performance data specified elsewhere in the contract documents.

6.54.5.5.4 Once the operating manual is approved by the Engineer, the **Contractor** shall submit four (4) copies.

6.54.6 QUALITY CONTROL

6.54.6.1 GENERAL

6.54.6.1.1 The **Contractor** shall provide qualified staff and ensure that measurement and testing devices are available to carry out any tests required under this Contract.

6.54.6.1.2 The **Contractor** shall notify the Engineer in writing at least fourteen (14) days in advance of the requested tests, and the Engineer shall have the option of inspecting the installation and being present when the tests are conducted.

6.54.6.1.3 No tests are to be conducted without the Engineer's authorization. Any flaws or defects that come to light during testing shall be rectified by the **Contractor** to the Engineer's satisfaction.

6.54.6.2 GROUND INTEGRITY CONTROL AND GROUND CIRCUIT RESISTANCE TESTS

6.54.6.2.1 Ground integrity control and ground circuit resistance tests shall be conducted before the electrical system is powered on.

6.54.6.2.2 The **Contractor** shall check the insulation between the conductor and the ground using an ohmmeter capable of inducing at least 1,000 V. The resistance between the conductor and the ground shall not be less than 10 megohms. This test shall be done for each circuit conductor.

6.54.6.2.3 The **Contractor** shall check the combined ground resistance using the fall-of-potential method; the value shall not be more than 25 ohms. The **Contractor** shall provide the Engineer with a drawing showing the measurement points and results.

6.54.6.3 DIELECTRIC STRENGTH TESTS

6.54.6.3.1 Before the power is turned on, the **Contractor** shall measure the dielectric strength of the circuits, main lines and equipment with a nominal voltage of not more than 350 V using a 500 V megohmmeter. Where the nominal voltage is between 350 and 600 V, measurements shall be taken using a 1,000 V megohmmeter.

6.54.6.3.2 The results of the dielectric strength tests shall be submitted to the Engineer in writing.

6.54.6.4 TESTS OF THE ELECTRICAL PRODUCTION AND DISTRIBUTION SYSTEMS

6.54.6.4.1 The **Contractor** shall conduct tests of the electrical production and distribution systems, including phase and voltage control and load balancing.

6.54.6.4.2 Circuits coming from the distribution panels and lighting system controls shall be tested after they are powered on.

6.54.6.5 LOAD BALANCING

6.54.6.5.1 The phase current at the distribution panels under normal loading shall be measured by the **Contractor** before the Interim Certificate of Completion is issued. Further, the distribution circuit connections shall be distributed so as to obtain the optimum current balance between the various phases and note any changes made to the original connections.

6.54.6.5.2 The **Contractor** shall measure the phase voltages at the load elements and adjust the transformer taps to ensure that the voltage obtained is within ±2% of the nominal voltage of the devices.

6.54.6.5.3 When the Interim Certificate of Completion is issued, the **Contractor** shall submit to the Engineer a report indicating the currents under normal loading measured on the phases and the neutrals of the distribution panels, dry transformers and motor control centres. The time and date of each load measurement and the voltage of the circuit at the time of testing shall be included in the report.

6.54.6.5.4 The installation, calibration and adjustment of circuit protection devices, such as overcurrent trip devices, relays and fuses, shall be checked and confirmed in writing in the report.

6.54.6.5.5 If a product is not CSA approved when it is approved on site, the **Contractor** shall make at its expense all the modifications needed to obtain CSA approval.

END OF SUBSECTION