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 relating to the electrical power distribution work covered by this Contract.

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

6.54.1.3 The requirements relating to the supply and installation of electrical cables are described in subsection 6.52 *Electrical Cables*.

6.54.2 MEASUREMENT UNITS

6.54.2.1 The measurement units and respective symbols thereof used in this subsection are described as follows:

Measurement Unit	Designation	Symbol
length	meter	m
length	millimeter	mm
electric resistance	megohm	MΩ
electric resistance	ohm	Ω
apparent power	voltampere	VA
electric potential difference	volt	V
temperature	Celsius degree	°C
frequency	hertz	Hz
electric current intensity	ampere	A

6.54.3 REFERENCE STANDARDS

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

6.54.3.1.1 (ACNOR(CSA)) Canadian Standards Association:

- CAN/CSA-C22.2 Nº 0 *General Requirements – Canadian Electrical Code, Part II*;
- CAN/CSA-C22.2 Nº 0.4 *Bonding of Electrical Equipment*;
- CAN/CSA-C22.2 Nº 4 *Enclosed and Dead-Front Switches (Tri-National standard, with ANCE NMX-J-162 and UL 98)*;
- CAN/CSA-C22.2 Nº 5 - *Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-National standard, with UL 489 and NMX-J-266-ANCE-2013)*;

- CAN/CSA-C22.2 Nº 14 *Industrial Control Equipment*;
- CAN/CSA-C22.2 Nº 29 *Panelboards and Enclosed Panelboards*;
- CAN/CSA C22.2 Nº 39 - *Fuseholder Assemblies*;
- CAN/CSA C22.2 Nº 41 - *Grounding and Bonding Equipment (Bi-National Standard, with UL467)*;
- CAN/CSA C22.2 Nº 106 *HRC-Miscellaneous Fuses*;
- CAN/CSA C22.10 *Quebec Construction Code - Chapter V, Electricity - Canadian Electrical Code, Part I with Quebec Amendments*;
- CAN3-C235 *Preferred Voltage Levels for AC Systems, 0 to 50 000 V.*

6.54.3.1.2 (IEEE) Institute of Electrical and Electronic Engineers:

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

6.54.3.1.3 (MTQ) Ministère des Transports du Québec:

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

6.54.4 MATERIALS

6.54.4.1 GENERAL

6.54.4.1.1 All electrical power distribution equipment shall be CSA approved.

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

6.54.4.1.3 The control panels and their components shall be factory-assembled.

6.54.4.2 GROUNDING MATERIALS AND EQUIPMENT

6.54.4.2.1 The grounding materials and equipment shall comply with standards CAN/CSA C22.2 Nº 0.4 and CAN/CSA C22.2 Nº 41.

6.54.4.2.2 The grounding materials and equipment shall be compatible with one another and shall meet the following requirements:

6.54.4.2.2.1 the electrode rods shall be made of copper-plated steel and shall be 3 m long and 19 mm in diameter;

6.54.4.2.2.2 the bare ground conductors shall consist of stranded copper wires and shall be annealed after cold-drawn and of the gauge indicated on the drawings;

6.54.4.2.2.3 the insulated ground conductors shall be RWU90 and green;

6.54.4.2.2.4 the accessories such as the bushings, clamps, connectors and jumpers required to complete the grounding system shall be of the type and dimension indicated on the drawings.

6.54.4.2.3 The grounding materials and equipment shall be manufactured by *Cadweld* or equivalent authorized by the Engineer.

6.54.4.3 FUSED AND NON-FUSED SWITCHES

6.54.4.3.1 The switches and switch boxes shall meet the requirements of standards CAN/CSA-C22.2 Nº 0, CAN/CSA-C22.2 Nº 4 and CAN/CSA C22.10. If the switch is installed inside a single-use box outdoors, it shall be CSA-certified Type 4X.

6.54.4.3.2 All switches required for the this Contract shall be supplied by the same manufacturer and shall comply with the drawings.

6.54.4.3.3 The switch boxes shall be made of Type 316 stainless steel.

6.54.4.3.4 The switches shall allow padlocking in the “closed” or “open” position.

6.54.4.3.5 If the switch is installed inside a single-use box outdoors, it shall have a door with a tamper-proof mechanical interlock that prevents the box from being opened when the lever is in the “closed” position.

6.54.4.3.6 The fuse holders of each switch shall be appropriate for the fuse category prescribed on the drawings and shall meet the requirements of standard CAN/CSA C22.2 Nº 39.

6.54.4.3.6.1 No adapter shall be used with the fuse holders.

6.54.4.3.7 The switches shall be equipped with a 347/600 VAC, 3-phase 4-wire solid neutral.

6.54.4.4 MOLDED CASE CIRCUIT BREAKERS

6.54.4.4.1 The molded case circuit breakers shall comply with standard CAN/CSA-C22.2 Nº 5 and shall be fast-closing and snap-action, manually and automatically operated and with compensation for an ambient temperature of 40°C.

6.54.4.4.2 The circuit breaker lugs shall be separated by a protective wall and shall be capable of accepting 8 to 1/0-gauge single conductor cables. The gauge of the single conductor wires is indicated on the drawings.

6.54.4.4.3 The circuit breaker insulation resistance shall be 10,000 MΩ at a voltage of 5000 VDC.

6.54.4.4.4 The circuit breakers shall be equipped with an insulating plate and bolts for fixing to the bus bars.

6.54.4.4.5 On multi-pole circuits, the common trip circuit breakers shall be equipped with a single lever.

6.54.4.4.6 The circuit breakers fitted with instantaneous trip magnetic components shall be designed to act only when the current value reaches the setting value. The circuit breaker setting value shall range between three (3) and eight (8) times the nominal current value.

6.54.4.5 FUSES

6.54.4.5.1 The fuses shall be high rupturing capacity (HRC) I-J fuses compliant with standard C22.2 N^{o} 106 and with the indications on the drawings.

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

6.54.4.6 CONTACTORS

6.54.4.6.1 The contactors shall comply with standards CAN/CSA-C22.2 N^{o} 14 and CAN/CSA-C22.2 N^{o} 29 and with the indications on the drawings.

6.54.4.6.2 The contactors shall, without limitation, have the following features:

6.54.4.6.2.1 be magnetic;

6.54.4.6.2.2 have three (3) normally open poles;

6.54.4.6.2.3 be equipped with four (4) types of contacts, including two (2) normally open auxiliary contacts and two (2) normally closed auxiliary contacts;

6.54.4.6.2.4 capable of being maintained at a minimum alternating current of 90 A;

6.54.4.6.2.5 capable of being operated at a voltage of 600 VAC;

6.54.4.6.2.6 have a coil supply at 120 VAC, 60 Hz.

6.54.4.6.3 The contactor insulation resistance shall be 10,000 MΩ at a voltage of 5000 VDC between the coil terminals.

6.54.4.6.4 The contactor insulating part and exposed parts shall have been treated with an antifungal agent.

6.54.4.7 SINGLE-PHASE TRANSFORMER

6.54.4.7.1 The single-phase transformer to power the photocell shall have a power of 350 VA, a primary voltage of 347 VAC and a secondary voltage of 120 VAC.

6.54.4.7.2 The single-phase transformer for the electrical power distribution on the Jacques Cartier bridge LS-15 overhead signage structure shall have electrical characteristics identical to those of the existing transformer.

6.54.4.8 PHOTOCELL

6.54.4.8.1 The photocell shall be designed for outdoor use at a 120 VAC power supply and a power of 1,500 VA.

6.54.4.8.2 A normally closed contact and a locking device with a « twist-lock » female socket are required for the photocell.

6.54.5 NOMINAL VOLTAGES

6.54.5.1 The nominal operating voltages of the new electricity systems under this Contract shall comply with standard CAN3-C235.

6.54.6 EXECUTION OF WORK

6.54.6.1 PLANNING

6.54.6.1.1 At least fourteen (14) days before the installation of the electrical components begins, the **Contractor** shall submit to the Engineer, for review, the technical data sheets for the switches, circuit breakers, fuses, contactors, transformers and photocells, including, without limitation:

6.54.6.1.1.1 the characteristic curves developed from the time/current constants for circuit breakers with an ampacity of 100 A and more, or a breaking capacity of 22,000 A symmetrical amperes and more at the system voltage;

6.54.6.1.1.2 the characteristics for each type of fuses used, including, without limitation, the average melting time at a given current, the I^2t value, to establish the coordination of the fuses, and the allowable peak current.

6.54.6.2 GROUNDING OF PRIMARY AND SECONDARY CIRCUITS

6.54.6.2.1 The **Contractor** shall install complete, permanent and continuous primary and secondary grounding systems as indicated on the drawings and in accordance with standards CAN/CSA C22.2 N^o 41 and CAN/CSA-C22.2 N^o 0.4 and with the manufacturer's recommendations.

6.54.6.2.2 Splicing on ground wires is prohibited.

6.54.6.2.3 A bonding conductor shall be carefully fixed on the outside of the rigid metal conduit and connected at each end to a coupler fitted with a grounding tab, to a weldless compression sleeve, a wire nut flange or a cap screw washer.

6.54.6.2.4 The grounding of the primary circuits shall be carried out according to the following requirements:

6.54.6.2.4.1 the connections to the grounding bars shall be carried out using standard connectors to crimp on the conductor;

6.54.6.2.4.2 mechanical connectors shall be used for the connections to equipment fitted with grounding tabs;

6.54.6.2.4.3 a bare, cold-drawn copper conductor, of the gauge indicated on the drawings, shall be installed to connect the secondary circuits and the dry-type transformers, as well as along all distribution cable tray routes. The copper wire shall also be tin-plated;

6.54.6.2.4.4 all equipment housings, raceways and distribution boards shall be grounded;

6.54.6.2.4.5 the electrical cable sheaths shall be grounded using a flexible copper conductor of the gauge indicated on the drawings, securely welded, and not fixed with a wire nut, to the sheath.

6.54.6.2.5 The grounding of the secondary circuits shall be carried out according to the following requirements:

6.54.6.2.5.1 the buried connections shall be made using Cadweld thermite welds or equivalent authorized by the Engineer;

6.54.6.2.5.2 the buried connections shall be made using permanent mechanical connectors or wrought copper compression connectors, controllable and compliant with standard IEEE 837;

6.54.6.2.5.3 mechanical connectors shall be used to connect devices equipped with grounding terminals;

6.54.6.2.5.4 a separate ground conductor shall be installed for each outdoor light fixture;

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

6.54.6.3 INSTALLATION OF CIRCUIT BREAKERS, CONTACTORS, SWITCHES AND FUSES

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

6.54.6.3.2 The circuit breakers, contactors, switches and fuses shall be installed in the power supply and distribution cabinets as indicated on the drawings and as directed by the Engineer.

6.54.6.3.3 The fuses shall be inserted into the fuse holders immediately before the circuit is switched on. To that effect, the fuses shall be inserted into the appropriate fuse holders and shall be perfectly matched in order to protect the designated electrical circuit.

6.54.6.3.4 A label containing the information on the model and capacity of the replacement fuses shall be affixed near each fuse holder. The label shall comply with standard CAN/CSA-C22.2 N^{o} 14.

6.54.6.3.5 The **Contractor** shall install the contactors and connect the auxiliary control devices.

6.54.6.3.6 The switches and contactors shall be identified by a 20 mm x 90 mm identification plate indicating the name of the controlled load. The plate shall be made of 3 mm thick lamicoid plastic with a black surface and white core mechanically fixed by means of self-tapping screws. The text to be engraved shall be at least 8 mm high.

6.54.6.4 REPLACEMENT AND MAINTENANCE PARTS

6.54.6.4.1 The **Contractor** shall, before the issuance of the Interim Certificate of Completion, supply three (3) replacement and maintenance fuses for each type of fuse installed.

6.54.6.4.2 The replacement and maintenance fuses shall be supplied in their original container. The container shall be identified by type, current and voltage of the fuse.

6.54.6.4.3 A list of the replacement and maintenance fuses supplied shall be submitted to the Engineer, for review, before the issuance of the Interim Certificate of Completion. This list shall include a description of the type, current and voltage of the fuses as well as the description of the circuit on which they can be used.

6.54.6.5 OPERATING MANUAL

6.54.6.5.1 The **Contractor** shall, before the issuance of the Interim Certificate of Completion, submit to the Engineer, for review, a manual containing the operating and performance sheets for the electrical systems and equipment installed under this Contract.

6.54.6.5.2 The operating sheets shall include, without however being limited to, the following:

6.54.6.5.2.1 the diagrams of the control circuits of each system, including the temperature control circuit;

6.54.6.5.2.2 a description of each system/installation and control devices thereof;

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

6.54.6.5.3 The performance sheets shall include, without however being limited to, the following:

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

6.54.6.5.3.2 Any other specific performance data specified elsewhere in the contract documents.

6.54.6.5.4 After the operating manual has been reviewed by the Engineer, the **Contractor** shall submit four (4) copies thereof.

6.54.7 QUALITY CONTROL

6.54.7.1 GENERAL

6.54.7.1.1 The **Contractor** shall ensure that the qualified personnel are present and that the measuring and testing devices are available to conduct the tests required under this Contract.

6.54.7.1.2 The **Contractor** shall inform the Engineer in writing, at least fourteen (14) days before the conduct of the requested tests, and the Engineer may, if he wishes to, inspect the installation and be present when the tests are conducted.

6.54.7.1.3 No tests shall be conducted without the authorization of the Engineer. Any flaws or defects that come to light during testing shall be rectified by the **Contractor** to the complete satisfaction of the Engineer.

6.54.7.2 GROUND CONTINUITY CONTROL AND GROUND CIRCUIT RESISTANCE TESTS

6.54.7.2.1 The ground continuity control and ground circuit resistance tests shall be conducted before the electrical system is switched on.

6.54.7.2.2 The **Contractor** shall check the insulation between the conductor and the ground using an ohmmeter capable of inducing at least 1000 VDC. The resistance between the conductor and the ground shall not be less than 10 MΩ. This test shall be conducted for each circuit conductor.

6.54.7.2.3 The **Contractor** shall check the combined ground resistance by the Fall-of-Potential Method and the value shall not exceed 25 Ω for a lighting circuit and 10 Ω for a circuit comprising electronic components. To this effect, the **Contractor** shall provide the Engineer with a sketch showing the measuring points and the results.

6.54.7.3 DIELECTRIC STRENGTH TESTS

6.54.7.3.1 Before the power is switched on, the **Contractor** shall measure the dielectric strength of the circuits, feeder circuits and equipment with a nominal voltage not exceeding 350 VAC using a 500 VDC megohmmeter. Where the nominal voltage ranges between 350 and 600 VAC, the measurements shall be taken using a 1000 VDC megohmmeter.

6.54.7.3.2 The results of the dielectric strength tests shall be consolidated in a document as a report and delivered to the Engineer.

6.54.7.4 TESTING OF THE ELECTRICAL POWER PRODUCTION AND DISTRIBUTION SYSTEMS

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

6.54.7.4.2 The circuits coming from the bypass panels and lighting system control devices shall be tested after they are switched on.

6.54.7.5 LOAD BALANCING

6.54.7.5.1 The phase current at the distribution panels under normal loads shall be measured by the **Contractor** before the issuance of the Interim Certificate of Completion. Furthermore, the connections of the bypass circuits shall be distributed so as to obtain the optimum current balance between the various phases and to note the changes made to the original connections.

6.54.7.5.2 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.

6.54.7.5.3 When the Interim Certificate of Completion is issued, the **Contractor** shall submit to the Engineer a report indicating the working currents under normal load measured on the phases and neutrals of the distribution panels, dry-type transformers and motor control centres. To this effect, the time at which and the date on which each load was measured, as well as the circuit voltage at the time of the verification, shall be included in the report.

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

6.54.7.5.5 If the product is not approved by the CSA Group at the time when it is approved on site, the **Contractor** shall make, at its expense, the modifications needed to obtain the CSA Group approval.

END OF SUBSECTION