MATERIAL SPECIFICATION FOR POWER SUPPLY EQUIPMENT

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2414.01 SCOPE

This specification covers the requirements for the following:

a) Supply control cabinet assembly Type 1 - 120/240 V, 100 A, 1-phase, 3-wire.

b) Supply control cabinet assembly Type 2A - 120/208 V, 100 A, 3-phase, 4-wire.

c) Supply control cabinet assembly Type 2B - 347/600 V, 100 A, 3-phase, 4-wire.

d) Supply control cabinet assembly Type 3 - 120/240 V, 100 A, 1-phase, 3-wire, no lighting contactor.

e) Distribution assembly - 347/600 V.

2414.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

CSA Standards

C9-2017	Dry-Type Transformers
C22.2 No. 0.12-M1985 (R2016)	Wiring Space and Wire Bending Space in Enclosures for Equipment Rated 750 V or Less
C22.2 No. 0.17-00 (R2018)	Evaluation of Properties of Polymeric Materials
C22.2 No. 0.4-2017	Bonding of Electrical Equipment

C22.2 No. 5-2016	Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures
C22.2 No. 9.0-1996 (R2016)	General Requirements for Luminaires
C22.2 No. 14-2018	Industrial Control Equipment
C22.2 No. 18.1-2013 (R2018)	Metallic Outlet Boxes
C22.2 No. 29-2015	Panelboards and Enclosed Panelboards
C22.2 No. 38-2018	Thermoset-Insulated Wires and Cables
C22.2 No. 41-2013 (R2017)	Grounding and Bonding Equipment
C22.2 No. 45.1-2007 (R2017)	Electrical Rigid Metal Conduit - Steel
C22.2 No. 45.2-2008 (R2013)	Electrical Metal Conduit - Aluminum, Red Brass, and Stainless Steel
C22.2 No. 55-2015	Special Use Switches
C22.2 No. 65-2018	Wire Connectors
C22.2 No. 66.1-2006 (R2015)	Low Voltage Transformers - Part 1: General Requirements
C22.2 No. 66.2-2006 (R2015)	Low Voltage Transformers - Part 2: General Purpose Transformers
C22.2 No. 76-2014	Splitters
C22.2 No. 83-M1985 (R2017)	Electrical Metallic Tubing
C22.2 No. 94.1-2015	Enclosures for Electrical Equipment, Non-Environmental Considerations
C22.2 No. 94.2-2015	Enclosures for Electrical Equipment, Environmental Considerations
C22.2 No. 106-2005 (R2014)	HRC - Miscellaneous Fuses
C22.2 No. 144.1-16	Ground Fault Circuit Interrupters
C22.2 No. 227.2.1-2014	Liquid-Tight Flexible Nonmetallic Conduit
C227.5-2008 (R2018)	Three-Phase Live-Front Pad-Mounted Distribution Transformers
G40.20-13/G40.21-13 (R2018)	General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
G164-2018	Hot Dip Galvanizing of Irregularly Shaped Articles
W59.2-M1991 (R2013)	Welded Aluminum Construction

Electrical Safety Authority (ESA)

Ontario Electrical Safety Code

Underwriter's Laboratories of Canada (ULC)

CAN/ULC-S102-10	Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

American National Standards Institute (ANSI)

B18.15-2008	Forged Eyebolts

ASTM International

A 480/A 480M-18	General Requirements for Flat Rolled Stainless Steel and Heat-Resisting Steel Plate, Sheet and Strip
A 489-18	Carbon Steel Lifting Eyes
A 666-15	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
B 209-14	Aluminum and Aluminum-Alloy Sheet and Plate
G 34-01(2018)	Test Method for Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)

IEEE

C62.11-2012	Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV)

National Equipment Manufacturers Association (NEMA)

NEMA 250-2014 Enclosure for Electrical Equipment (1000 Volts Maximum)

2414.04 DESIGN AND SUBMISSION REQUIREMENTS

2414.04.01 Design Requirements

2414.04.01.01 Power Supply Equipment Requirements

Supply control cabinet assemblies shall be according to the Contract Documents. Completed assemblies shall be “service entrance ready.” The complete assembly shall pass Electrical Safety Authority (ESA) equipment inspection and have an ESA label of approval. These approvals shall be obtained prior to the unit being shipped.

Completed distribution assemblies shall be approved according to the Ontario Electrical Safety Code.

2414.04.02 Submission Requirements

2414.04.02.01 Working Drawings

The Contractor shall submit four sets of Working Drawings to the Contract Administrator at least 14 Days prior to the commencement of fabrication. An Engineer shall review the Working Drawings and affix a reviewed stamp with his or her signature to the Working Drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

As a minimum, the Working Drawings for supply control cabinet assemblies shall include the following information:

a) Detailed dimensioned layout, including sections and details to show enclosures, equipment layouts and mounting arrangements, and exact weights.

b) Detailed bill of materials.

c) Wiring diagrams.

d) Details of equipment nameplates.

As a minimum, the Working Drawings for distribution assemblies shall include the following information:

a) Plans, elevations, sections, and details to show enclosures, structural details, equipment layouts and mounting arrangements, anchor bolt locations, and overall weights.

b) Detailed bill of materials.

c) Wiring diagrams.

d) Details of equipment nameplates and notices.

Once fabrication of the equipment has commenced, materials and dimensions shown on the submitted Working Drawings shall not be changed.

2414.05 MATERIALS

2414.05.01 Enclosures

2414.05.01.01 Supply Control Cabinet Assemblies

Enclosures shall be welded 14 gauge stainless steel type 304 and shall have a No. 2B finish outside according to ASTM A 666 and ASTM A 480.

The panelboard cover for the supply control cabinet assembly shall be manufactured to accommodate the number of standard-sized single-pole branch circuit breakers as specified in the Contract Documents. Unused openings shall be covered with removable blank covers or inserts.

The removable internal equipment panel consisting of a combination backboard and drip shield shall be fabricated from 14 gauge stainless steel type 304 and shall have a No. 2B finish according to ASTM A 666 and ASTM A 480.

Barriers and dead-front panels shall be fabricated from clear thermoplastic polycarbonate according to CSA C22.2 No. 0.17.

2414.05.01.02 Distribution Assemblies

Exterior cubicles shall be according to CSA C22.2 No. 94.1 and CSA C22.2 No. 94.2, enclosure NEMA 250, Type 3.

Enclosures for electrical equipment inside the cubicle shall be according to CSA C22.2 No. 94.1 and CSA C22.2 No. 94.2, enclosure NEMA 250, Type 1.

The exterior of the cubicle shall be fabricated from 5052-H32 marine-type sheet aluminum according to ASTM G 34. The sheet aluminum shall be 4.7 mm thick minimum and reinforced. Fabrication shall be according to ASTM B 209 for 5052-H32 sheet aluminum.

The cabinet base shall be steel H-beam according to CSA G40.21, Grade 260W, and shall be hot dip galvanized according to CSA G164.

Equipment backplate supports shall be aluminum brackets welded to the aluminum sheeting. All other cabinet materials shall be sheet, formed, or cast aluminum or stainless steel.

Eyebolts shall be drop forged steel and according to ASTM A 489 and ANSI/ASME B18.15.

All mounting hardware shall be stainless steel.

2414.05.01.02.01 Insulation and Ventilation

Enclosure insulation shall be rated at minimum R 8/RSI l.4 and have a flame spread rating not greater than 25 when tested according to CAN/ULC-S102. Insulation shall be applied to the entire surface of the walls, doors, and ceilings, except areas for openings to the exterior.

Enclosure ventilation shall be according to the Contract Documents. Ventilation openings shall be screened, vermin proof, and tamper proof louvres.

2414.05.02 Breakers

Breakers shall be according to CSA C22.2 No. 5 for use with copper bus.

2414.05.03 Contactors

Contactors shall be according to CSA C22.2 No. 14.

2414.05.04 Lightning Arrestors

Lightning arrestors shall be according to IEEE C62.11.

2414.05.05 Outlet Boxes and Fittings

Outlet boxes and fittings shall be according to CSA C22.2 No. 18.1.

2414.05.06 Thermoset Insulated Wires and Cables

All interconnecting wires and cables shall be copper with type RWU90 insulation and according to CSA C22.2 No. 38.

2414.05.07 Panelboards and Enclosed Panelboards

Panelboards and enclosed panelboards shall be according to CSA C22.2 No. 29. Buses shall be copper.

Panelboards shall accept bus bar bolt-on breakers and all bus work shall be of copper construction. All interconnecting wire and cables shall be of copper construction and bending radius according to CSA C22.2 No. 0.12.

2414.05.08 Grounding and Bonding Materials

All equipment used for grounding and bonding shall be according to CSA C22.2 No. 0.4 and C22.2 No. 41.

2414.05.09 Rigid Metal Conduits

Rigid metal conduits shall be according to CSA C22.2 No. 45.1 and CSA C22.2 No. 45.2.

2414.05.10 Dry-Type Distribution Transformers

Dry-type distribution transformers shall be according to CSA C9.

2414.05.11 Switches

Switches shall be according to CSA C22.2 No. 55.

2414.05.12 Ground Fault Circuit Interrupter (GFCI) Receptacles

Ground fault circuit interrupter (GFCI) receptacles shall be according to CSA C22.2 No. 144.1.

2414.05.13 Non-Metallic Liquid Tight Conduits and Connectors

Non-metallic liquid tight conduits and connectors shall be according to CSA C22.2 No. 227.2.1.

2414.05.14 Specialty Control Transformers

Specialty control transformers shall be according to CSA C22.2 No. 66.1 and CSA C22.2 No. 66.2.

2414.05.15 Electrical Metallic Tubing (EMT)

Electrical metallic tubing (EMT) shall be according to CSA C22.2 No. 83.

2414.05.16 Enclosure Lamps

Enclosure lamps shall be according to CSA C22.2 No. 9.0.

2414.05.17 Splitters

Splitters shall be according to CAN/CSA C22.2 No. 76.

2414.05.18 High Rupturing Capacity (HRC) Fuses

High rupturing capacity (HRC) fuses shall be according to CSA C22.2 No. 106.

2414.05.19 Wire Connectors

Wire connectors shall be according to CSA C22.2 No. 65.

2414.05.20 Neutral Bus Bars

Neutral bus bars shall be copper.

2414.07 PRODUCTION

2414.07.01 General

General requirements for electrical work shall be as specified in the Contract Documents.

2414.07.02 Supply Control Cabinet Assemblies

2414.07.02.01 Cabinet Fabrication

Supply control cabinet assemblies shall be assembled and wired according to the Contract Documents.

2414.07.02.02 Enclosures

The enclosure for the supply control cabinet assembly shall be constructed so that exposure to weather, moisture, or external splashing do not impair the effectiveness of the enclosed electrical equipment. The enclosure shall be manufactured to meet the requirements of NEMA 250, Type 4X.

The enclosure shall consist of the following:

a) Pole mounting brackets according to the Contract Documents.

b) Doors with:

i. An inside mounted, continuous, piano-type stainless steel hinge.
ii. A latching mechanism to hold the door open at 90° and 150-180°.
iii. A copper or stainless steel flexible flat braid jumper connected between the door and the cabinet by means of welded studs.
iv. A stainless steel padlocking provision.
v. A stainless steel three-point padlocking handle with a nylon roller wheel complete with bearing.
vi. Tamperproof stainless steel mounting hardware accessible from the inside.

vii. A door handle that travels and stops below the keyhole with minimum 25 mm clearance and rotates 90° pointing straight down for the closed position and pointing horizontally for the open position.

c) Removable internal equipment panel with a combination backboard and drip shield. The drip shield shall be formed so that the electrical components mounted on the backboard are not affected by moisture forming on the interior at the top of the enclosure.

d) Barriers formed according to CSA C22.2 No. 29 separating the service cables from the branch circuits and the photoelectric controller cables.

e) Internal dead-front panels for the main breaker and circuit breaker sections that prevent unsafe contact by service personnel with the live circuits from all sides.

f) A printed schedule for the supply control cabinet identifying circuits mounted on cardboard, inserted in a clear plastic bag, and permanently attached to the inside of the door.

Dead-front panels shall be formed so that the circuit breaker panel has to be removed prior to the main breaker panel can be removed. Both panels shall be supplied with quarter-turn screw latches welded to the dead-front panels.

2414.07.03 Distribution Cabinet Assemblies

2414.07.03.01 Cabinet Fabrication

Cabinets shall consist of self-supporting sheet aluminum cubicles and formed aluminum framework welded to form open bottom cubicles. The cabinet shall be tamperproof according to CSA C22.2 No. 94.1 and CSA C22.2 No. 94.2. Eyebolts suitable for lifting the cabinet shall be attached to the formed aluminum framework.

A minimum of three aluminum channels shall be mounted to the full height for the back side of the cabinet. Channels shall be welded to the aluminum sheeting and framework and may form part of the structural framework.

2414.07.03.02 Backplates

Aluminum backplates shall be installed for mounting of electrical components. Backplates shall be securely bolted to the aluminum channels using bolts through the channels with the heads tack-welded to the channels. Backplates shall be sized so that the total weight of the backplate plus electrical components does not exceed 70 kg.

Aluminum backplates shall be finished with fire-rated paint and provided with isolating means to minimize galvanic action between the backplates and the steel electrical components.

2414.07.03.03 Doors

Doors shall be according to CSA C227.5.

Doors shall be lapping and reinforced for strength and rigidity. Each door shall consist of:

a) An inside mounted, continuous, piano-type stainless steel hinge.

b) Two latching mechanisms to hold the door open at 90° and 150-180°, one at the top and one at the bottom.

c) A copper or stainless steel flexible flat braid jumper connected between the door and the cabinet by means of welded studs.

d) A stainless steel padlocking provision.

e) A stainless steel three-point padlocking handle with a nylon roller wheel complete with bearing.

f) Tamperproof stainless steel mounting hardware accessible from the inside.

g) A door handle that travels and stops below the keyhole with minimum 25 mm clearance and rotates 90° pointing straight down for the closed position and pointing horizontally for the open position.

h) Screened, vermin proof, and tamperproof louvres to give ventilation as required. All louvres shall be equipped with racks and 305 x 406 x 25 mm metal reusable filters.

2414.07.03.04 Welding

All welding shall be according to CSA W59.2. Welding on aluminum shall be done by the gas metal arc process.

2414.07.03.05 Cabinet Finish

Exterior and interior components of the cabinet shall have a natural aluminum finish with all welds and scratches ground smooth. Cabinets with scratches more than 0.5 mm wide, 0.5 mm deep, or 150 mm long shall not be accepted.

2414.07.03.06 Bonding and Grounding of Electrical Equipment

All non-current carrying metal parts of the electrical equipment shall be bonded according to CSA C22.2 No. 0.4.

2414.07.03.07 Spare Parts

Each cabinet shall include one set of contacts, packaged and identified for each contactor, and one set of fuses for each switch. A 450 x 150 x 150 mm spare part box shall be fabricated from sheet aluminum and mounted in a location inside the cabinet.

2414.07.03.08 Metering

Distribution assemblies shall have meter sockets acceptable to the power supply authority and mounted on a removable backplate in the metering cabinet cubicle.

2414.07.03.09 Warning Signs

Warning signs shall be as specified in the Contract Documents and be prominently displayed on the outside of each exterior door.

2414.07.03.10 Ground Bus

A continuous copper ground bus and ground connectors shall be installed in the distribution assembly according to CSA C227.5. The ground bus shall have four connectors suitable for #2/0 AWG cables in the lighting and services compartment, four connectors suitable for #6 AWG cables in the cubicle and extension cabinet assembly, and one connector suitable for #2/0 AWG cable in the metering cubicle for field connections.

2414.07.03.11 Electrical Components

The electrical components shall be as shown in Table 1.

2414.07.03.11.01 Installation of Electrical Components

Component arrangements shown on the Contract Documents are indicative of the general requirements and adjustments that may be made to component locations to suit different sizes of enclosures and regulations or physical requirements regarding spacing of enclosures.

Wiring shall be installed in flexible non-metallic liquid-tight conduit, rigid metal conduit, or electrical metallic tubing between enclosures.

2414.07.03.11.02 Nameplates for Electrical Components

The following nameplates shall be engraved lamacoid nameplates with 6 mm high, 1.5 mm stroke width black letters on yellow background fastened with stainless steel or aluminum pop rivets on the identified equipment for identification:

a) To the main feed switch for distribution assemblies:

NOTICE READ BEFORE OPERATING Advanced Traffic Management Systems are 24 hour operational and must remain ON unless necessary to de-energize for safety reasons.

b) To the 600 V utility disconnect:

NOTICE This breaker controls the feeder to the 120/240 V utility panel. Some circuits are 24 hour operational and must remain ON unless necessary to de-energize for safety reasons.

All other nameplates shall be engraved lamacoid with black letters on white background.

2414.07.03.11.03 Panelboard Schedules

A printed schedule for each panelboard shall be provided indicating equipment served and a description of circuit breaker sizes for each panel as specified in the Contract Documents. The schedule shall be mounted on cardboard, inserted in a clear plastic bag, and hung on the inside of the main door panel.

2414.07.04 Markings

Markings shall be engraved on a stainless steel plate permanently attached with stainless steel or aluminum pop rivets to the outside of the door and located in a highly visible location. Each power supply equipment shall have identification markings showing the following:

a) Assembly manufacturer's name or trademark.

b) Enclosure manufacturer's name or trademark.

c) Standard designation OPSS 2414.

d) Date of manufacture (i.e., yyyy-mm-dd).

e) kVA rating (distribution assembly only).

f) Total weight.

The manufacturer shall attach the label SERVICE ENTRANCE READY on the dead front panel of the supply control cabinet assembly.

2414.08 QUALITY ASSURANCE

2414.08.01 Inspection

The Contract Administrator shall be notified a minimum of three Business Days prior to the start of fabrication for the power supply equipment.

The Contract Administrator shall have free access to the place of manufacture of the power supply equipment for the purpose of inspecting and examining plant records and certificates; materials used; process of manufacturing, including welding and galvanizing; and to make any tests as may be considered necessary, while the power supply equipment is being fabricated.

The Contract Administrator and ESA shall be notified when the power supply equipment is ready for inspection.

All power supply equipment may be subject to an inspection by the Contract Administrator prior to shipment.

2414.09 OWNER PURCHASE OF MATERIAL

2414.09.01 Packaging and Shipment

The supplier shall provide four copies of Working Drawings when required by the Owner. Working Drawings shall include all detailed dimensions and a complete list of component materials and accessories.

The supplier is responsible for loading, delivery, and off-loading of power supply equipment to designated areas. Power supply equipment shall be subject to inspection during and on completion of off-loading. If any damage to the power supply equipment is encountered during the inspection, the supplier shall be responsible for the necessary corrective measures, which are subject to the approval of the Owner.

The supplier shall advise the Owner three Business Days prior to the shipping date of the intent to deliver and confirm that arrangements for off-loading has been made.

2414.09.02 Measurement and Payment

For measurement purposes, a count shall be made of the number of power supply equipment delivered and accepted.

Payment at the price specified in the purchasing order shall be for the supply of the power supply equipment delivered to the destination on the date and time specified.

The cost of all testing, except that performed by the Owner, shall be included in the price.

TABLE 1
Electrical Components for Distribution Cabinet Assemblies

Electrical Components	Quantity
Service entrance disconnect - 600 V, 3-pole, fusible complete with three HRC1 Class R time delay fuses. Fuse holders and distribution blocks suitable for service cable.	1
Main feed switch - 600 V, 400 A, 3-pole, non-fusible switch complete with terminals suitable for service cable.	1
Lighting system disconnect - 600 V, 225 A, 3-pole, 4-wire, solid neutral complete with terminals suitable for lighting system feed cable.	1
Utility disconnect - 600 V, 30 A, 2-pole.	1
Lighting contactor - 600 V, 200 A, 3-pole, 120 V coil electrically operated, electrically held.	1
Lighting system panelboard - 600 V, 225 A, 3-phase, 4-wire, solid neutral, surface mount, enclosed, suitable for 48 branch circuits, 30 A, 1-pole, bolt-on type breakers.	1
Utility panelboard - 240 V, 3-wire, single phase, 100 A, surface mount, enclosed, suitable for 15 A, 1-pole, bolt-on type breakers.	1
Advanced Traffic Management System combination panelboard - 347/600 V, 225 A, 3-phase, 4-wire, solid neutral, surface mount, enclosed, suitable for 48 branch circuits, breakers suitable for load.	1
Relamp switch - 125 V, 15 A, 1-pole, toggle type, mounted in a utility box with steel cover.	1
Light switch - 125 V, 15 A, 1-pole, toggle type mounted in a utility box with steel cover.	1
GFCI receptacle - 125 V, 15 A, mounted in a utility box with steel cover.	1
Main splitter - 600 V, 400 A, 4-wire, surface mounted.	1
Incandescent lighting luminaire - 125 V, 150 W, wall-mounted type, enclosed, complete with gasket and clear glass globe.	1
Secondary lightning arrestor - 650 V, 3-pole, thyrite type, mounted on each load panel.	3
Dry type transformer -120/240/600 V, 15 KVA, 60 Hz, single phase.	1