

PART 1 GENERAL1.1 RELATED SECTIONS

- .1 All division 26 sections.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations, and all Ontario Amendments.
 - .2 CAN/CSA-C22.3 No. 7-10, Underground Systems, Includes Update No. 1 (2011).
 - .3 CAN3-C235-83 (R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE 100 (SP1122)-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE 100 (SP1122).

1.4 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English and French.
- .4 Use one nameplate or label for each language.

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review single line electrical diagrams under plexiglass and locate.
 - .1 In existing LAN room.
- .3 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Submit electronic copy of drawings and product data to Departmental Representative.
 - .6 If changes are required, notify Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available from any supplier, submit such equipment and material to inspection authorities for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .5 Submit certificate of acceptance from inspection authority upon completion of Work to Departmental Representative.
- .5 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.
- .6 Short circuit and coordination study: provide short circuit and protection coordination study for facility. All supplied equipment ratings to meet minimum recommendations of study.
- .7 Provide arc flash study for facility. Provide arc flash labelling for all existing and new equipment.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings:
 - .1 Site Meetings: as part of Manufacturer's Field Services described in Part 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule after award.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Storage in accordance with Section 01 00 10 - General Instructions.

1.8 SYSTEM STARTUP

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available from any manufacturer, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

- .2 Control wiring and conduit: in accordance with Section 26 09 24 - Lighting Control Devices - Low Voltage.
- .3 Conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of Authority Having Jurisdiction, inspection authorities and Departmental Representative.
- .2 Lamicoid signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core, mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. " as approved by Departmental Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.
- .10 Devices to be labelled with source panel and circuit number.

2.6 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered and coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 3 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other	Green	Blue
Communication		
Systems		
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other	Red	Yellow
Security		
Systems		

2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment; colour to be determined by Departmental Representative.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

2.9 TEMPORARY CONSTRUCTION LIGHTING

- .1 Provide temporary construction lighting in and around facility.

PART 3 EXECUTION3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do underground systems in accordance with CAN/CSA-C22.3 No. 7 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 400 mm.
 - .2 Above top of counters or counter splash backs: 175 mm.
 - .3 In mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Telephone and interphone outlets: 400 mm.
 - .5 Wall mounted telephone and interphone outlets: 1200 mm.
 - .6 Fire alarm stations: 1200 mm.
 - .7 Fire alarm bells or horns: 2100 mm.
 - .8 Television outlets: 400 mm.
 - .9 Wall mounted speakers: 2100 mm.
 - .10 Clocks: 2100 mm.
 - .11 Door bell pushbuttons: 1200 mm.
 - .12 Emergency battery packs: at 200 mm from finished ceiling.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 FIELD QUALITY CONTROL AND LOAD BALANCING

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

- .3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 TEMPORARY CONSTRUCTION LIGHTING

- .1 Supply and install temporary construction lighting.
- .2 Progressively relocate temporary lighting to allow for electrical work.
- .3 Progressively remove temporary lighting, all power feeds and electrical boxes back source upon installation of final project lighting. Temporary lighting wiring cannot remain upon completion of the project.

3.9 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

3.10 SEISMIC

- .1 Contractor to provide seismic bracing and restraint systems for all electrical equipment as required by applicable building codes. Provide engineered stamp shop drawings for all seismic bracing.

PART 1 GENERAL1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No.18-98 (R2003), Outlet Boxes, Conduit Boxes, and Fittings.
 - .2 CSA C22.2 No.65-13, Wire Connectors (Tri-National standard, with UL 486A-486B and NMX-J-543-ANCE).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .4 Divert unused wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

PART 2 PRODUCTS2.1 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable, mineral insulated cable, flexible conduit, as required to: CAN/CSA C22.2 No.18.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
 - .2 Install fixture type connectors and tighten. Replace insulating cap.

END

PART 1 GENERAL1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .4 Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts.
- .5 Section 26 50 00 - Lighting.

1.2 PRODUCT DATA

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 PRODUCTS2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketted.
- .3 Copper conductors: size as indicated, with thermoplastic insulation type TWU for underground in ducts; T90 Nylon for building wiring; rated at 600 V.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.

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- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
 - .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 600 V.
 - .4 Inner jacket: polyvinyl chloride material.
 - .5 Armour: interlocking aluminum.
 - .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
 - .7 Fastenings:
 - .1 One hole malleable iron, steel, aluminum straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1 m centers.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
 - .8 Connectors:
 - .1 Watertight, approved for TECK cable.

2.3 MINERAL-INSULATED CABLES

- .1 Conductors: solid bare soft-annealed copper, size as indicated.
- .2 Insulation: compressed powdered magnesium oxide or silicon dioxide to form compact homogeneous mass throughout entire length of cable.
- .3 Outer covering: annealed seamless copper sheath, Type M1 rated 600 V, 250°C.
- .4 Two hour fire rating.
- .5 Connectors: field installed approved for MI cable.
- .6 Termination kits: field installed approved for MI cable.
- .7 Factory installed splice kits where lengths exceed manufactured standard lengths.

2.4 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.

- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Type: ACWU90 PVC jacket over thermoplastic armour and compliant to applicable Building Code classification for this project wet locations.
- .5 Connectors: anti-short connectors.
- .6 Only for final connections at devices/equipment.

2.5 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath: thermoplastic jacket.
- .2 Type: low energy 300 V control cable: solid annealed copper conductors sized as indicated. LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: polyethylene.
 - .2 Shielding: tape coated with paramagnetic material braid over each conductor.
 - .3 Overall covering: polyethylene jackets.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local Authority Having Jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (01000 V).
- .2 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.

- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 In underground ducts in accordance with Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts.
 - .3 In surface and lighting fixture raceways in accordance with Section 26 50 00 - Lighting.

3.4 INSTALLATION OF TECK 90 CABLE (0 -1000 V)

- .1 Use Teck 90 for final flexible connections at motors and equipment. Teck cable is to be used for final connections of equipment.
- .2 Group cables wherever possible on channels.
- .3 Install cable exposed, securely supported by straps and hangers.

3.5 INSTALLATION OF MINERAL-INSULATED CABLES

- .1 Use mineral insulated cables for fire pump 2 H rated feeds.
- .2 Install cable exposed, securely supported by straps and hangers.
- .3 Support 2 hour fire rated cables at 1 m intervals.
- .4 Make cable terminations by using factory-made kits.
- .5 Cable terminations: use thermoplastic sleeving over bare conductors.
- .6 Where cables are buried in cast concrete or masonry, sleeve for entry and exit of cables.
- .7 Do not splice cables unless indicated.

3.6 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.

PART 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 41-13, Grounding and Bonding Equipment (Tri-National standard, with NMJ-J-590-ANCE and UL 467).

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper long barrel compression connectors to CSA C22.2 No. 41 as required sized for conductors.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Bond and ground as required to CSA C22.2 No.41.

END

PART 1 GENERAL1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 22 11 16 - Domestic Water Piping.
- .3 Section 22 13 17 - Drainage Waste and Vent Piping - Cast Iron and Copper.
- .4 Section 33 11 16 - Site Water Utility Distribution Piping.
- .5 Section 33 31 13 - Public Sanitary Utility Sewerage Piping.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 PRODUCTS

2.1 PIPE/TANK TRACING HEATING CABLES

- .1 Type A: 19 mm - 25 mm pipe, self-regulating heating cable with nickel plated copper bus wires (16 AWG) with radiation cross linked semiconductive heating matrix. Tinned copper braid ground. Polyolefin primary and overall jackets. Heating capacity: 16 W/m; for use with 120 V power supply.
- .2 Type B: for pipes larger than 25 mm, self-regulating heating cable with nickel plated copper bus wires (16 AWG) with radiation cross linked semiconductive heating matrix. Tinned copper braid ground. Polyolefin primary and overall jackets. Heating capacity: 26 W/m; for use with 120 V power supply.

2.2 CONTROLS

- .1 Thermostat: remote line sensing type with 3 m capillary by same manufacturer as heat trace for 25mm - 103 mm pipe.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install Type A and B heating cables in accordance with manufacturer's instructions. Co-ordinate installation with pipe insulation application.

- .2 Install Type A and B heating cables in accordance with manufacturer's instructions. Distribute and fasten cable evenly on pipe using pipe strap or tape at maximum spacing 0.5 m. Ensure that heating cables do not touch or cross each other. Run only cold leads in conduit and ensure sensing capillary does not touch cable. Ground shield to building ground. Coordinate cable installation with insulation application. Loop additional cable at fittings, valves, and flanges.
- .3 Make power and control connections.
- .4 Apply 'electrically traced' labels to the outside of the thermal insulation.

3.3 FIELD QUALITY CONTROL

- .1 Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Use 2500 V Megger to test cables for continuity and insulation value and record readings before, during and after installation. Measure insulation resistance between heating cable bus wires and the metallic braid before installation, after installation on pipe and completion of all accessory kits.
- .3 Where resistance of 50 megohms or less is measured, stop work and advise Departmental Representative.
- .4 Verification requirements include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE 837-2002, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association, (CSA International)
 - .1 CSA Z32-09, Electrical Safety and Essential Electrical Systems in Health Care Facilities, Includes Update No. 1 (2010), Update No. 2 (2010).

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required.
- .2 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.

- .3 Insulated grounding conductors: green, type RW90.
- .4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process, permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Connect building structural steel and metal siding to ground by welding copper to steel.

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- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
 - .11 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
 - .12 Ground secondary service pedestals.

3.2 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.3 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of LAN room.
- .2 Ground items of electrical equipment to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.4 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Sound, fire alarm, intercommunication systems as indicated.
 - .3 LAN room, ground room and flooring.

3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local Authority Having Jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END

PART 1 GENERAL1.1 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted and suspended.

PART 3 EXECUTION3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.

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- .3 Beam clamps to secure conduit to exposed steel work.
 - .6 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
 - .7 For surface mounting of two or more conduits use channels at 1 m on centre spacing.
 - .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
 - .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
 - .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
 - .11 Do not use supports or equipment installed for other work for conduit or cable support.
 - .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
 - .13 Fasten electrical supports only to steel structure. Do not fasten electrical supports to underside of steel deck.

PART 1 GENERAL1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations, and all Ontario Amendments.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 PRODUCTS2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.
- .6 Cover plates: brushed stainless steel.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 CONDUIT BOXES

- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.4 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

PART 1 GENERAL1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18-98 (R2003), Outlet Boxes, Conduit Boxes, and Fittings.
 - .2 CSA C22.2 No. 45.1-07 (R2012), Electrical Rigid Metal Conduit - Steel (Tri-National standard, with UL 6 and NMX-J-534-ANCE-2007).
 - .3 CSA C22.2 No. 56-04 (R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985 (R2013), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-06 (R2011), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA-C22.2 No. 227.3-05 (R2010), Nonmetallic Mechanical Protection Tubing (NMPT) (Bi-National standard, with UL 1696).

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2 PRODUCTS

2.1 CABLES AND REELS

- .1 Provide cables on reels or coils.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.

2.2 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .4 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3.

2.3 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.
- .5 Conduit to be supported by structural steel and open web steel joists.

2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 50 mm and larger conduits.
- .3 Steel set screw connectors for EMT.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

- .1 Polypropylene.

PART 3 EXECUTION3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms, in unfinished areas.
- .3 Use electrical metallic tubing (EMT) in all areas except where specified otherwise.
- .4 Use rigid pvc conduit underground and exterior to building, in crawl space.
- .5 Use flexible metal conduit for connection to motors in dry areas, connection to surface or recessed fluorescent fixtures, work in movable metal partitions.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .7 Minimum conduit size for lighting and power circuits: 19 mm.

- .8 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend steel conduit over 19 mm diameter.
- .10 Install fish cord in empty conduits.
- .11 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .12 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect cables from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 PRODUCTS

2.1 CABLE PROTECTION

- .1 38 x 140 mm planks pressure treated with clear or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable for cable installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

- .2 Perform tests using qualified personnel.
 - .1 Include necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds.
 - .1 Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests:
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

- .1 Repair damage to adjacent materials caused by cables installation.

PART 1 GENERAL1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC content.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Test reports:
 - .1 Submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions.
 - .4 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Basic system description:
 - .1 Control system: by one manufacturer and assembled from compatible components.
 - .2 The Low Voltage Switching System shall consist of relay panel assemblies, low voltage switches, occupancy sensors and/or photocells, as well as their associated wiring.
 - .3 The relay panel shall be mounted on the exterior of the building in a NEMA 4 enclosure as indicated on the drawings. The numbered relays in the panel shall be wired to control the power to each load as indicated on the Panel Wiring Schedules included in the drawings. All power wiring will be identified with the circuit number controlling it at the load.
 - .4 Low voltage switches shall be mounted in the spaces as indicated on the drawings. Low voltage wiring from the switches and sensors to the relay panel shall be in conduit; CLASS 2 as required by the OESC and local standards. Each low voltage wire shall be labeled with the relay number (1-48) at each switch or sensor. Use only properly color coded, stranded #20 AWG (or larger) wire as indicated on the drawings. All relays and switches shall be tested after installation to confirm proper operation and the loads recorded on the directory card in each panel.
 - .5 The panels shall provide a mounting bracket for the addition of master ON/OFF sequencers or photosensor control modules. These devices shall be totally compatible with the manual operation of the low voltage switches and occupancy sensors; and, in the event of a sequencer or photocontrol failure, the switches and occupancy sensors shall continue to operate to provide relay control.

- .6 Modular Relay Panels shall be UL listed and consist of the following:
 - .1 Tub: Empty NEMA 4 enclosure sized to accept an interior with 1-12 relays.
 - .2 Interior: Bracket and circuit board backplane. Interiors shall be sized to accept 1-12 relays. Each relay shall be capable of direct ON/OFF control by a low voltage switch or occupancy sensor. Relays shall be momentary pulsed mechanically latching contactors rated at 20 amps, 120 VAC. They shall attach to the Interior by a single plug-in connector.
 - .3 Power Supply: Transformer assembly with two 40VA transformers with separate secondaries; one providing power to relays and associated low voltage switches and sensors, the second providing power for accessory devices. Transformers include internal overcurrent protection with automatic reset and metal oxide varistor protection against powerline spikes. 120/60 Hz. +/- 10%.
 - .4 Cover: Surface with captive screws in a hinged, lockable configuration. A wiring schedule directory card shall be affixed to the cover's back to allow identification of circuits/relays/loads controlled when the door is open.

2.2 REMOTE CONTROL SWITCHES

- .1 Single pole, double throw, momentary contact, standard duty, rated 15 A, 25 V, double push-button action with pilot lights.

2.3 LOW VOLTAGE RELAYS

- .1 Electrically operated by momentary impulse, mechanically latched until activated.
- .2 Two coil solenoid type with one coil to close relay contacts and one coil to open relay contacts.
- .3 Operating voltage: 24 V, AC.
- .4 Load contacts: 20 A, 120 V, AC.
- .5 Auxiliary contacts for pilot light.
- .6 Coloured pre-stripped leads.

2.4 RECTIFIER

- .1 Selenium type: 24 V, AC, 60 Hz input, 0.36 A continuous duty output.
- .2 Silicon type: 24 V, AC, 60 Hz input, 20 A intermittent duty output.

2.5 MANUAL CONTROL

- .1 Individual remote control switches as indicated in guard huts.
- .2 Six circuit manual master selector switch mounted in 100 mm square box with:
 - .1 Master lock-out switch.
 - .2 Individual red jewelled pilot lights.
 - .3 Mount in existing trailer at guard station.

2.6 LOW VOLTAGE WIRE

- .1 All low voltage wiring shall be color coded to match the relays, switches, and sensors. It must also be UL listed as conforming to Class 2 or Class 2P wiring requirements.
- .2 Switch color codes as follows:
 - .1 Red/Black/White.
 - .2 Red/Black/White/Yellow (pilot).
 - .3 Red/Black/White/Blue (locator).
- .3 Remote relay color coding.
 - .1 Red/Black/Blue/Yellow/Yellow.
- .4 Occupancy Sensor or Photo Sensor or Photo Sensor.
 - .1 Red/Black/White/Blue (same as locator switch).

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

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- .2 Actuate control units in presence of Departmental Representative to demonstrate lighting circuits are controlled as designated.
 - .3 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
 - .4 Verification requirements include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM D4059-00(2010), Standard Test Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C2-M91 (R2003), Single-Phase and Three-Phase Distribution Transformers, Types ONAN and LNAN.
 - .2 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations, and all Ontario Amendments.
- .3 FM 3990:1997, Less or Nonflammable Liquid-Insulated Transformers.
- .4 Institute of Electrical and Electronics Engineers (IEEE)
 - .1 IEEE C57.12.00-2010, IEEE Standard General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers.
 - .2 IEEE C57.12.10-2010/Cor 1-2012, IEEE Standard Requirements for Liquid-Immersed Power Transformers--Corrigendum 1: Correction of 5.1.9--Sudden Pressure Relay.
 - .3 IEEE C57.12.28-2005, IEEE Standard for Pad-Mounted Equipment - Enclosure Integrity.
 - .4 IEEE C57.12.70-2011, IEEE Standard for Standard Terminal Markings and Connections for Distribution and Power Transformers.
 - .5 IEEE C57.12.80-2010, IEEE Standard Terminology for Power and Distribution Transformers.
 - .6 IEEE C57.12.90-2010, IEEE Standard Test Code for Liquid-Immersed Distribution, Power and Regulating Transformers and IEEE Guide for Short-Circuit Testing of Distribution and Power Transformers.
- .5 UL XPLH - Guide for Transformers, Distribution, Liquid-Filled Type, over 600V.

1.3 SUBMITTALS

- .1 The manufacturer shall provide the following information for review and evaluation by the Departmental Representative.
 - .1 Shop Drawings showing layout, dimensions, voltage, phasing and continuous current capacity.
 - .2 Conduit entry location, cable termination sizes, mounting.

- .2 Manufacturer shall provide final, as-built drawings. Installation, Operation and Maintenance manuals shall be supplied.
- .3 The following checked data shall be submitted with the proposal:
 - .1 Core losses @ 85°C or @ 20°C.
 - .2 Winding losses.
 - .3 Exciting current @ 100% and 110% rated voltage.
 - .4 Percent impedance.
 - .5 Efficiencies must be provided at loading levels of 100%, 75%, 50% and 25%.
 - .6 Percent regulation must be provided at 0.8 PF and 1.0 PF.

1.4 QUALITY ASSURANCE

- .1 The manufacturer shall have specialized in the design, manufacture and assembly of liquid filled transformers.
- .2 The manufacturer shall have a documented quality assurance program.
- .3 All units shall be tested for the following:
 - .1 No-Load (85°C) losses at 100% and 110% rated voltage.
 - .2 Total (85°C) losses at rated current.
 - .3 Percent impedance (85°C) at rated current and tap extremes.
 - .4 Excitation current (100% and 110% voltage) test.
 - .5 Winding resistance measurement tests and tap extremes.
 - .6 Ratio tests using all tap settings.
 - .7 Polarity and phase relation tests.
 - .8 Applied and induced potential tests.
 - .9 Full wave and reduced wave impulse test.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

PART 2 PRODUCTS

2.1 RATINGS

- .1 The transformer shall be designed in accordance with this specification and shall have the following ratings:
 - .1 100 kVA. 2400 V primary, 120/240 V secondary.
 - .2 60 Hz.
 - .3 Temperature rise 65°C.

- .4 Impedance: 4%Z ANSI Standard
- .2 Primary voltage and the basic impulse insulation level (BIL) shall be:
 - .1 2400 V Delta, Distribution Transformer - 60 kV, Power Transformer - 60 kV BIL.
- .3 Secondary voltage and the basic impulse insulation level (BIL) shall be:
 - .1 240 Delta with 120 Mid-Tap, Distribution Transformer - 30 kV, Power Transformer - 45 kV BIL.
- .4 Cooling Class:
 - .1 ONAN.
- .5 Liquid Type:
 - .1 Mineral transformer oil.

2.2 TAPS

- .1 The transformer shall be furnished with full capacity high-voltage taps. The tap changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the tap changer per IEEE C57.12.10. Taps shall be provided on the higher voltage of dual voltage primary units. The tap changer switch shall be an externally operated, snap action switch with a lever handle. Padlocking provisions are standard. The unit shall have one of the following tap configurations:
 - .1 Two - 2½% taps above and below rated voltage.

2.3 WINDING TEMPERATURE RISE RATING

- .1 The transformer shall have a 65°C average winding temperature rise rating. The above winding temperature rise shall not exceed 65°C when loaded at base kVA rating.

2.4 IMPEDENCE

- .1 The percent impedance voltage, as measured on the rated voltage connection, shall be per IEEE C57.12.10 - latest revision.

2.5 COOLING

- .1 The transformer shall be cooled by the natural circulation of air over the tanks surfaces and any corrugate or radiators if required, allowing only the base kVA rating shall be provided with Class ONAN.

2.6 HIGH VOLTAGE BUSHINGS AND TERMINALS

- .1 Two high voltage bushings.

2.7 LOW VOLTAGE BUSHINGS AND TERMINALS

- .1 The low-voltage line and neutral bushings shall be sidewall mounted molded epoxy for secondaries less than 1000V and with a 6-Hole NEMA spade. Low-voltage bushings above 1000 V shall be electrical grade wet process porcelain. The low-voltage bushings shall be located in Segment 2 or Segment 4 opposite of the specified high-voltage configuration.

2.8 TANK AND TERMINAL COMPARTMENT

- .1 The core and coil shall be vacuum processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the windings shall be energized to heat the coils and drive out moisture and the transformer will be filled with preheated filtered degassed insulating fluid. The core shall be manufactured from burr-free, grain-oriented silicon steel and shall be precisely stacked to eliminate gaps. The coil shall be insulated with B-stage, epoxy coated, diamond pattern, insulating paper, which shall be thermally cured under pressure to ensure proper bonding of conductor and paper. The winding shall be of copper construction.
- .2 All transformer oil must be bulk tested for polychlorinated biphenyl's (PCBs) per ASTM D4059 and certified, upon request, as having no detectable level of PCB.
- .3 Panel type radiators or corrugate type cooling is welded directly to the tank when additional cooling is required.
- .4 The tank must be welded using precision cut, cold-rolled steel plate and equipped with extra-heavy duty, welded-in-place lifting lugs and jacking pads. The tank base must be designed to allow skidding or rolling in any direction.
- .5 The transformer shall be of sealed tank construction of sufficient strength to withstand a pressure of 0.4846 bar without permanent distortion and 1.034 bar without rupturing.
- .6 The tank shall include a pressure relief device as a means to relieve tank pressure in excess of pressure resulting from normal operation. The venting and sealing characteristics shall be as specified to meet the requirements of Factory Mutual Standard 3990.
- .7 The tank shall be cleaned with an alkaline cleaning agent to remove grease and oil. An iron phosphate coating shall then be chemically bonded to the metal to assure coating adhesion and retard corrosion. The tank shall be primed with an electro-deposited epoxy coating to provide a barrier against moisture, salt and corrosives. The top-coat shall be a liquid polyurethane coating to seal and add

ultraviolet protection. The tank coating shall meet all performance requirements in IEEE C57.12.28 - latest revision.

- .8 Tank and terminal compartment:
 - .1 The tank shall be complete with an anodized aluminum laser engraved nameplate.

2.9 PROTECTION

- .1 The overcurrent protection scheme provided with the transformer shall consist of one of following attributes and meet the requirements of Factory Mutual Standard 3990, which limits the I²t energy inside the transformer tank. If for any reason a special protection scheme is required it shall be clearly stated on the inquiry or data sheet.
 - .1 The high-voltage overcurrent protection scheme provided with the transformer shall be a loadbreak bayonet assembly with a flapper valve to minimize oil spillage. Overcurrent protection shall be provided by a bayonet expulsion fuse mounted in series with partial range fuses with an interrupting rating of 30,000 A.

2.10 PRIMARY OVERVOLTAGE PROTECTION

- .1 Primary overvoltage protection shall consist of:
 - .1 Intermediate Class MOV arresters. Arrester housing shall be porcelain.
 - .2 600 amp air disconnect switch that shall be current-limiting fuse.

2.11 FEATURES

- .1 The following standard features shall be provided:
 - .1 De-energized tap changer.
 - .2 25 mm upper fill plug with filter press connection.
 - .3 25 mm drain/sampling valve.
 - .4 Automatic pressure relief device.
 - .5 Lifting lugs (4).
 - .6 Liquid level gauge.
 - .7 Dial type thermometer.
 - .8 Pressure/vacuum gauge.
 - .9 SS ground pads (4).
 - .10 Any additional accessories will be specified on the inquiry.

2.12 ACCESSORIES

- .1 Hanger irons and adapter plates.
- .2 Top filter press connection.

2.13 DRAWINGS

- .1 The following will be provided by request in electronic format:
 - .1 Construction drawings.
 - .2 Record drawings.
 - .3 Approval drawings.
 - .4 CAD drawings.
 - .5 CD available upon request.

2.14 ARRESTERS

- .1 The arresters shall be:
 - .1 MOV Intermediate Class Arrester.

PART 3 EXECUTION3.1 INSTALLATION

- .1 Install transformer as shown on project drawings and in accordance with manufacturer's Instruction/Installation Manual.
- .2 Grounding should be per project drawings and in accordance with local codes and standards and in compliance with the CEC.

3.2 ADJUSTMENTS AND CLEANING

- .1 Remove debris from jobsite and wipe dust and dirt from all components.
- .2 Repaint marred and scratched surfaces with touch up paint to match original finish.

3.3 QUALITY CONTROL

- .1 Each transformer shall receive all standard routine tests as required by IEEE C57.12.00 and performed as specified by IEEE C57.12.90.
- .2 Short Circuit withstand capability shall be verified by full short circuit tests on similar or larger units in accordance with the latest revision of IEEE C57.12.00 and IEEE C57.12.90. Short Circuit withstand verification shall be submitted to the purchaser, upon request, prior to shipment of the transformers.
- .3 Device functionality test shall be performed.
- .4 The test facility used to perform loss tests shall utilize test equipment with calibration traceable to NIST or an approved equal 3rd party laboratory.

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- .5 A certified test report shall be submitted and shall contain the test data for each transformer serial number manufactured. The certified test report shall as a minimum contain the data as specified in IEEE C57.12.90.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Carry out following insulation tests using megger with 20,000 megohm scale and resulting insulation resistance corrected to base of 20 °C.
- .1 High voltage to ground with secondary grounded for duration of test.
 - .2 Low voltage to ground with primary grounded for duration of test.
 - .3 High to low voltage.
- .3 Inspect primary and secondary connections for tightness and for signs of overheating.
- .4 Inspect and clean bushings and insulators.
- .5 Check oil level and temperature indicators.
- .6 Set transformer taps to rated voltage as specified.
- .7 Inspect for oil leaks and excessive rusting.
- .8 Inspect oil level.
- .9 Check fuses for correctness of type and size.
- .10 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

PART 1 GENERAL1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.
- .2 Section 26 28 16.02 - Moulded Case Circuit Breakers.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.29-11, Panelboards and Enclosed Panelboards.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

PART 2 PRODUCTS2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.

- .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 250 V panelboards: bus and breakers rated for 22 kA (symmetrical) interrupting capacity, as indicated, or as per ratings identified in short circuit study.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Two keys for each panelboard and key panelboards alike.
- .6 Copper bus with neutral of same ampere rating as mains.
- .7 Mains: suitable for bolt-on breakers.
- .8 Recess trim with concealed front bolts and hinges.
- .9 Trim and door finish: baked grey enamel.
- .10 NEMA 4 weatherproof enclosure.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for receptacles, fire alarm clock outlet, emergency, door supervisory, intercom, stairway, exit and night light circuits.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .3 Connect loads to circuits.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.

END

PART 1 GENERAL1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 42-10, General Use Receptacles, Attachment Plugs and Similar Wiring Devices.
 - .2 CAN/CSA-C22.2 No. 42.1-00 (R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D), Includes General Instruction No. 1 (2000), Update No. 2 (2001), Update No. 3 (2002), Update No. 4 (2003), Update No. 5 (2007), Update No. 6 (2011).
 - .3 CSA C22.2 No.55-M1986 (R2012), Special Use Switches.
 - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20), Includes Update No. 1 (2012).

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 SWITCHES

- .1 20 A, 120 V, single pole, three-way, four-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose ac switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No. 42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CAN/CSA-C22.2 No. 42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Stainless steel, vertically brushed cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.

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- .5 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
 - .6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
 - .7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical as indicated.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical as indicated.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3 Cover plates:
 - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END

PART 1 GENERAL1.1 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.2 No. 5-13, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489 and NMX-J-266-ANCE-2013).

1.2 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include time-current characteristic curves for breakers with ampacity of 100 A and over and with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .3 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Reduction Workplan.

PART 2 PRODUCTS2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters, and Accessory high-fault protectors: to CSA C22.2 No. 5.
- .2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.

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- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
 - .5 Circuit breakers to have minimum 22 kA symmetrical rms interrupting capacity rating.

2.2 THERMAL MAGNETIC BREAKERS DESIGN A

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 SOLID STATE TRIP BREAKERS DESIGN D

- .1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase ground fault short circuit protection.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

PART 1 GENERAL1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.14-13, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2-2000 (R2005), Controllers, Contactors and Overload Relays Rated 600 V.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for contactors and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for contactors for incorporation into manual.
- .3 Include operating information required for start-up, synchronizing and shut-down of generating units.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect contactors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 PRODUCTS

2.1 CONTACTORS

- .1 Contactors: to CSA C22.2 No.14.
- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled.
- .3 Breaker combination contactor as indicated.
- .4 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .5 Mount in NEMA 4 enclosure unless otherwise indicated.
- .6 Include following options in cover:
 - .1 Hand-Off-Auto selector switch.
- .7 Control transformer: factory wired and installed in contactor enclosure.

2.2 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Size 4 nameplate indicating name of load controlled as indicated.

PART 3 EXECUTION3.1 INSTALLATION

- .1 Install contactors and connect power wires and auxiliary control devices.
- .2 Identify contactors with nameplates or labels indicating panel and circuit number.
- .3 Test contactors in accordance with 26 05 00 - Common Work Results for Electrical.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by contactor installation.

PART 1 GENERAL1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN3-C13-M83 (R2004), Instrument Transformers.
 - .2 CSA C22.2 No.5-13, Molded-case Circuit Breakers, Molded-Case Switches and Circuit-breaker Enclosures (Tri-national standard, with UL 489 and NMX-J-266-ANCE-2013).
 - .3 CSA C22.2 No. 178.1-12, Transfer Switch Equipment (Tri-National Standard, with NMX-J-672 ANCE and UL 1008).
- .2 American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA ICS 2-2000 (R2005), Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 V.
- .3 International Electrotechnical Commission (IEC)
 - .1 IEC 60947-6-1-2005, Low-voltage Switchgear and Controlgear - Part 6-1: Multiple Function Equipment - Transfer Switching Equipment.
- .4 Underwriter's Laboratories
 - .1 UL 1008-12, Standard for Transfer Switch Equipment.

1.3 SYSTEM DESCRIPTION

- .1 Automatic load transfer equipment to:
 - .1 Monitor voltage on phases of normal power supply.
 - .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
 - .3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.
 - .4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.
 - .5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include:
 - .1 Make, model and type.
 - .2 Load classification:
 - .1 Motor load: 15 kW.
 - .3 Single line diagram showing controls and relays.
 - .4 Description of equipment operation including:
 - .1 Automatic starting and transfer to standby unit and back to normal power.
 - .2 Test control.
 - .3 Manual control.
 - .4 Automatic shutdown.
 - .5 Transfer switch to be 22 kAIC rated or as required per short circuit study.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Detailed instructions to permit effective operation, maintenance and repair.
- .3 Technical data:
 - .1 Schematic diagram of components, controls and relays.
 - .2 Illustrated parts lists with parts catalogue numbers.
 - .3 Certified copy of factory test results.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Instrument transformers: to CAN3-C13.
- .2 Contactors: to ANSI/NEMA ICS 2.
- .3 Transfer Switch assembly to: CSA C22.2 no. 178.1 and UL 1008, qualified and listed to IEC 60947-6-1.

2.2 CONTACTOR TYPE TRANSFER EQUIPMENT

- .1 Contact Type Transfer Equipment: to CSA C22.2 No.178.1.
- .2 NEMA 4 rated enclosure. System to be designed to operate outdoors in temperatures of -40°C to +40°C.
- .3 Two-single phase contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, solenoid operated, open type with CSA enclosure.
- .4 Rated: 120/240V, 60Hz, 400 A. 3 wire, solid neutral.
- .5 Main contacts: silver surfaced, protected by arc disruption means.
- .6 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.
- .7 Auxiliary contact: gold plated, to initiate emergency generator start-up on failure of normal power.
- .8 Fault withstand rating: 35 kA symmetrical for 3 cycles with maximum peak value of 200 kA.
- .9 Lever to operate switch manually when switch is isolated.
- .10 Solid neutral bar, rated: 400 A.
- .11 Front replaceable main and arcing contacts.
- .12 Programmable microprocessor controller with keypad and LCD display.
- .13 Centrally located terminal block for customer control connections.
- .14 Heavy duty 16mm industrial grade control switches and indicating lights.

- .15 Switch position indicators and true source acceptability lights.
- .16 Standard ground lug connection.
- .17 Four auxiliary contacts, two contacts closed when switch is in normal position and two contacts closed when switch is in emergency position.
- .18 Pre-transfer contacts to initiate load shed prior to energizing emergency source.

2.3 CONTROLS

- .1 Selector switch - four position "Test", "Auto", "Manual", "Engine start".
 - .1 Test position - Normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.
 - .2 Auto position - Normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.
 - .3 Manual position - Transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.
 - .4 Engine start position - Engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.
- .2 Control transformers: dry type with 120V secondary to isolate control circuits from:
 - .1 Normal power supply.
 - .2 Emergency power supply.
- .3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
 - .1 Voltage sensing: single phase for normal power and single phase for emergency, solid state type, adjustable drop out and pick up, close differential, 2V minimum undervoltage and over voltage protection.
 - .2 Time delay: normal power to standby, adjustable solid state, 0 to 60s.
 - .3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 0 to 60s delay.
 - .4 Time delay on retransfer from standby to normal power, adjustable 0 to 60s.
 - .5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable 20s intervals to 10 min.
 - .6 Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 5s intervals to 180s.
 - .7 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.
- .4 Alarm indicator light when switch is in any position other than "AUTO".

2.4 ACCESSORIES

- .1 Pilot lights to indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel and remote.

- .2 Auxiliary relay to provide 2 N.O. and 2 N.C. contacts for remote alarms.
- .3 Instruments:
 - .1 Digital true rms, indicating type 2% accuracy, flush panel mounting:
 - .1 Voltmeter: ac, scale 0 to 1000 V.
 - .2 Ammeter: ac, scale 0 to 400 A.
 - .3 Frequency meter: scale 55 to 65 Hz.
- .4 Manual bypass:
 - .1 Fully rated, to permit bypass to emergency source.
 - .2 Manufactured by transfer switch, manufacture and operation fully integrated with transfer switch.

2.5 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Control panel:
 - .1 For selector switch and manual switch: size 5 nameplates.
 - .2 For meters, indicating lights, minor controls: size 3 nameplates.
 - .3 Nameplates to include:
 - .1 Source name, location and voltage.

2.6 SOURCE QUALITY CONTROL

- .1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested.
- .2 Tests:
 - .1 Operate equipment both mechanically and electrically to ensure proper performance.
 - .2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.
 - .3 Check voltage sensing and time delay relay settings.
 - .4 Check:
 - .1 Automatic starting and transfer of load on failure of normal power.
 - .2 Retransfer of load when normal power supply resumed.
 - .3 Automatic shutdown.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate, install and connect transfer equipment.

.2 Check relays and solid state monitors and adjust as required.

.3 Install and connect battery and remote alarms.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Energize transfer equipment from normal power supply.

.3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.

.4 Set selector switch in "Manual" position and check to ensure proper performance.

.5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

.6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 min, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.

.7 Repeat, at 1 h intervals, 5 times, complete test with selector switch in each position, for each test.

PART 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1-04, For Lamp Ballast - Line Frequency Fluorescent Lamp Ballast.
 - .2 NEMA/ANSI C82.4-02 (R2007), Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.
- .2 ASTM International Inc.
 - .1 ASTM F1137-11e1, Standard Specification for Phosphate/Oil Corrosion Protective Coatings for Fasteners.
- .3 Canadian Standards Association (CSA International)
- .4 ICES-005-09, Radio Frequency Lighting Devices (RFLDs).
- .5 Institute of Electrical and Electronics Engineers (IEEE)
 - .1 IEEE C62.41.1-2002 (R2008), IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - .2 IEEE C62.41.2-2002/Cor 1-2012, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits/ Corrigendum 1: Deletion of Table A.2 and Associated Text.
- .6 Underwriters' Laboratories of Canada (ULC)

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative.
 - .3 Photometric data to include: VCP Table where applicable and spacing criterion.
- .3 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Divert unused metal materials from landfill to metal recycling facility.
- .5 Disposal and recycling of fluorescent lamps as per local regulations.
- .6 Disposal of old PCB filled ballasts.

PART 2 PRODUCTS

2.1 BALLASTS

- .1 Metal halide ballast:
 - .1 Rating: 120 V, 60 Hz, for use with 1-50W metal halide lamp. Provide circuitry for quartz re-strike standby light where indicated.
 - .2 Totally encased and designed for 40°C ambient temperature.
 - .3 Power factor: minimum 95% with 95% of rated lamp lumens.
 - .4 Type: super constant wattage autotransformer.
 - .5 Input voltage range: plus or minus 10% of nominal.
 - .6 Minimum starting temperature: minus 30°C at 90% line voltage.
 - .7 Mounting: integral with luminaire.
 - .8 Current crest factor: 1.7 maximum current.

2.2 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.3 LUMINAIRES

- .1 Fixture A:
 - .1 610mm x 610mm recessed LED troffer.
 - .1 Total plenum depth 63mm maximum.
 - .2 3800 to 4000 lumen output.

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- .3 LEDs rated to 50,000 hrs @40°C.
 - .4 47W input.
 - .5 3000K colour temperature.
 - .6 120V.
 - .7 Colour: white.
 - .2 Fixture B:
 - .1 610mm linear glass vanity wall sconce.
 - .1 Frosted glass with brushed nickel end caps.
 - .2 T5 - 20W lamp.
 - .3 120V.
 - .4 Mounted horizontally.
 - .3 Fixture C:
 - .1 T8 fluorescent strip with wire guard.
 - .2 T8 electronic cold weather ballast.
 - .3 Single T8-32W lamp.
 - .4 120V.
 - .5 Wire guard.
 - .4 Fixture D:
 - .1 LED flood light.
 - .1 Wide beam IP66 rated.
 - .2 12,000 lumen output, 127W.
 - .3 4,000K colour temperature.
 - .4 Tenon mounted.
 - .5 120V.
 - .6 Textured black finish.
 - .5 Fixture E:
 - .1 Yoke mounted small round MH flood.
 - .1 Small round flood, user adjustable on site without tools.
 - .2 50W metal halide, electronic ballast.
 - .3 Adjustable medium beam, IP66 rated.
 - .4 Glare shield/visor over top of fixture.
 - .5 120V.
 - .6 Fixture to be cool to the touch to permit adjustment while fixture is illuminated.
 - .7 233mm round diameter.
 - .8 Textured black finish.
 - .6 Fixture F:
 - .1 Metal MH wallpack.
 - .1 50W metal halide.
 - .2 Super constant wattage auto transformer.
 - .3 Full cutoff fixture.
 - .4 Integral photo cell.
 - .5 120V.
 - .6 Textured grey finish.

PART 3 EXECUTION3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

3.2 WIRING

- .1 Connect luminaires to lighting circuits:
 - .1 Install flexible or rigid conduit for luminaires as indicated.

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 1 GENERAL1.1 RELATED SECTIONS

- .1 Section 26 05 21 - Wires and Cables (0-1000 V).
- .2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.141-10, Emergency Lighting Equipment, Includes Update No. 1 (2011).

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

- .4 Develop Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 V, AC.
- .3 Output voltage: 24 V DC.
- .4 Operating time: 30 minutes.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .10 Lamp heads: integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 4 W.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: white.
- .13 Auxiliary equipment:
 - .1 Ammeter.
 - .2 Voltmeter.
 - .3 Test switch.
 - .4 Battery disconnect device.
 - .5 AC input and DC output terminal blocks inside cabinet.

- .6 Shelf.
- .7 Self test and alarm.
- .8 Cord and single twist-lock plug connection for AC.
- .9 RFI suppressors.

2.2 WIRING OF REMOTE HEADS

- .1 Conduit: type EMT, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: T90 type in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized as indicated in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.
- .4 Test in the presence of the Departmental Representative. Complete connected system demonstrating system maintains lights for minimum 30 minutes.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by emergency lighting installation.

PART 1 GENERAL1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-10, Emergency Lighting Equipment, Includes Update No. 1 (2011).
 - .2 CSA C860-11, Performance of Internally-Lighted Exit Signs, Includes Update No. 1 (2011).
- .2 National Building Code of Canada (NBC) - 2010.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 101-2012, Life Safety Code.
- .4 ISO 3864-1:2011, Graphical symbols -- Safety Colours and Safety Signs -- Part 1: Design Principles for Safety Signs and Safety Markings.
- .5 ISO 7010:2012, Graphical symbols -- Safety Colours and Safety Signs -- Registered Safety Signs.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 PRODUCTS

2.1 STANDARD UNITS

- .1 Exit Lights: to CSA C22.2 No. 141, ISO 7010, and NBC 2010.
- .2 'Running Man' standard legend.
- .3 Housing: extruded aluminum housing, white finish.
- .4 Face and back plates: extruded aluminum, brushed aluminum finish.
- .5 Lamps: 1.8 W total system wattage.
- .6 Operation: designed for over 100,000 hours of continuous operation without relamping.
- .7 Face plate to remain captive for relamping.
- .8 Green running Man per ISO 7010.
- .9 Exit Sign Colour to ISO 3864-1, green lighted graphic.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

