

Part 1 General

1.1 REFERENCES

- .1 Definitions:
 - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Reference Standards:
 - .1 Authorities Having Jurisdiction
 - .1 Canadian Electrical Code C22.1-15.
 - .2 Manitoba Fire Code 2011.
 - .3 National Fire Code of Canada 2010.
 - .4 ASHRAE Standards
 - .2 CSA Group
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, 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 6 number of copies of 600 x 600 mm minimum size drawings and product data to authority having jurisdiction.
 - .6 If changes are required, notify Departmental Representative of these changes before they are made.
- .3 Certificates:
 - .1 Provide CSA certified equipment.
 - .2 Where CSA certified equipment is not available, submit such equipment to authority having jurisdiction for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for 6 for incorporation into manual.
 - .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 Post instructions where directed.
 - .4 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .5 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 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.
- .3 Language operating requirements: provide identification labels for control items in English.
- .4 Use one label for each language.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide equipment in accordance with Section 01 61 00 - Common Product Requirements.

- .2 Equipment to be CSA certified. Where CSA certified equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.3 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 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems as shown on mechanical drawings.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction.
- .2 Decal signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

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

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with labels as follows:
 - .1 Nameplates: lamicoid 3 mm melamine, 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 labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.
- .9 Shall match existing, complete with fed from locations, room numbers and matching lamacoid colour.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered 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, to match existing.

2.8 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 15 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 Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.9 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 "equipment green" finish.
 - .2 Paint indoor switchgear and distribution enclosures light gray.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for 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 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

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

3.3 NAMEPLATES AND LABELS

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

3.4 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 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.

3.6 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 to match existing condition first and then the following heights unless indicated otherwise.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
Above top of counters or counter splash backs: 175 mm.
 - .2 In mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Telephone and interphone outlets: 300 mm.
 - .5 Fire alarm stations: 1200 mm.
 - .6 Fire alarm visual, audible, and combination devices. 2350mm
 - .7 Doorbell pushbuttons: 1200 mm.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.8 FIELD QUALITY CONTROL

- .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 - ACTION AND INFORMATIONAL 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 Circuits originating from branch distribution panels.
 - .2 Lighting and its control.
 - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .4 Systems: fire alarm.
- .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 - ACTION AND INFORMATIONAL 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.

3.9 SYSTEM STARTUP

- .1 Instruct 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.

3.10 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.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .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)

1.3 ACTION AND INFORMATIONAL 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 wire and box connectors 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 wire and box connectors 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.
- .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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of sized to fit copper conductors as required.

- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 NEMA to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for stranded round copper conductors bar.
 - .3 Clamp for stranded aluminum conductors .
 - .4 Bolts for copper conductors.
- .4 Clamps or connectors for armoured cable, TECK cable flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors 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 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2 NEMA.

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.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

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

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE Jacketted.
- .3 Copper ACM alloy Aluminum conductors: size as indicated, with thermoplastic insulation type TWU TWH T90 Nylon rated at 600 V.
- .4 Neutral supported cable: 1 2 3 phase insulated conductors of Copper Aluminum and one neutral conductor of Copper Aluminum steel reinforced, size as indicated. Type: NS75 NS90 Insulation: Type NS-1 rated 300 V Type NSF-2 flame retardant rated 600 V.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 Fastenings:
 - .1 One hole steel 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 1500 mm centers.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

2.3 ARMOURED CABLES

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

- .3 Armour: interlocking type fabricated from galvanized steel strip.
- .4 Type: ACWU90 jacket over thermoplastic armour and compliant to applicable Building Code classification for this project wet locations.
- .5 Connectors: anti short connectors.

2.4 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath : cotton braid thermoplastic jacket, and armour of closely wound aluminum wire.
- .2 Type: low energy 300 V control cable: solid stranded annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: PVC TW TW 40 degrees C TWH polyethylene.
 - .2 Shielding: tape coated with paramagnetic material tape coated with diamagnetic material wire braid metallized tapes over each conductor pair group over conductors.
 - .3 Overall covering: PVC jackets polyethylene jackets lead sheath aluminum sheath interlocked armour of flat galvanized steel aluminum strip copper strip.

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 before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 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 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 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.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by staples straps hangers.

3.5 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.

3.6 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL 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 hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 SUPPORT CHANNELS

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

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hangers and supports 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 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole malleable iron straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1500 mm on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

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.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1, 20th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit samples for floor box in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

Part 2 Products

2.1 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.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

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 walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 73 mm for receptacles and communication outlets.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 16, 21 and 27 mm conduit. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

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

2.7 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 35mm 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.

Expansion and Redevelopment of the Emerson Port of Entry
Emerson, MB

Section 26 05 32
OUTLET BOXES, CONDUIT BOXES AND
FITTINGS

PWGSC Project No. R.068431.001

Page 3 of 3

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.3 ACTION AND INFORMATIONAL 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.

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.

2.2 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings with.
- .4 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal steel aluminum.
- .6 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 1500 mm on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

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 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

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 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 conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in unfinished areas.
- .3 Surface mount conduits.
- .4 Use rigid hot dipped galvanized steel threaded conduit except where specified otherwise.
- .5 Use epoxy coated conduit underground.
- .6 Use electrical metallic tubing (EMT) except in cast concrete above 2.4 m not subject to mechanical injury.
- .7 Use rigid pvc conduit underground in corrosive areas.
- .8 Use flexible metal conduit for connection to motors in dry areas connection to recessed incandescent fixtures without prewired outlet box.

- .9 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .10 Minimum conduit size for lighting and power circuits: 19 mm.
- .11 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .12 Mechanically bend steel conduit over 19 mm diameter.
- .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .14 Install fish cord in empty conduits.
- .15 Run 2-NPS 1 25 mm spare conduits up to ceiling space and 2-NPS 1 25 mm spare conduits down to ceiling space from each flush panel.
 - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete surface type box.
- .16 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .17 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 IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.

- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.
 - .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

END OF SECTION

Part 1 General

- .1 CSA International
 - .1 CAN/CSA-Z809-08, Sustainable Forest Management.
- .2 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .3 Insulated Cable Engineers Association, Inc. (ICEA)
- .4 Sustainable Forestry Initiative (SFI)
 - .1 SFI-2010-2014 Standard.

1.2 ACTION AND INFORMATIONAL 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 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 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.

Part 2 Products

2.1 CABLE PROTECTION

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

2.2 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts 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 DIRECT BURIAL OF CABLES

- .1 After sand bed in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable.
 - .1 Do not pull cable into trench.
- .2 Include offsets for thermal action and minor earth movements.
 - .1 Offset cables 150 mm minimum for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- .3 Make termination and splice only as indicated leaving 0.6 m minimum of surplus cable in each direction.
 - .1 Make splices and terminations in accordance with manufacturer's written recommendations using approved splicing kits.
- .4 Underground cable splices not acceptable.
- .5 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable or in accordance with manufacturer's written recommendations; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
- .6 Cable separation:
 - .1 Maintain 75 mm minimum separation between cables of different circuits.
 - .2 Maintain 300 mm minimum horizontal separation between low and high voltage cables.
 - .3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.
 - .4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.
 - .5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
 - .6 Install treated planks on lower cables 0.6 m minimum in each direction at crossings.

- .7 After sand protective cover specified in Section 31 23 33.01 - Excavating, Trenching and Backfilling, is in place, install continuous row of overlapping 38 x 140 pressure treated planks as indicated to cover length of run.

3.3 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.

3.4 MARKERS

- .1 Mark cable every 150 m along cable duct runs and changes in direction.
- .2 Mark underground splices.
- .3 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- .4 Install concrete cable markers within 180 m from each side of runway centreline; 45 m from each side of taxi way centreline; 50 m from edge of taxi ramps or aprons.
- .5 Install cedar post type markers.
- .6 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.5 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 Acceptance Tests:
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 Leakage Current Testing:
 - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
 - .2 Hold maximum voltage for specified time period by manufacturer.
 - .3 Record leakage current at each step.
- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.6 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.

3.7 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 100-04, Motors and Generators.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC M1-7-1992, Standard for Motors and Generators.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba, Canada.
 - .2 Indicate dimensions, recommended installation procedure, wiring diagrams, sizes and location of mounting bolt holes and recommended support method.
- .3 Quality Assurance Submittals:
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
 - .1 Provide maintenance data for fractional horsepower motors for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 FRACTIONAL HORSEPOWER MOTOR

- .1 Non-hazardous locations: to CSA C22.2 No. 100 EEMAC M1-7.
- .2 Motor with inherent overheating protectors.

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 wiring, flexible connections and grounding.
- .2 Check rotation before coupling to driven equipment.

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.

END OF SECTION

Part 1 General

- .1 CSA International
 - .1 CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.

1.2 ACTION AND INFORMATIONAL 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 photoelectric devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit 1 sample of each component proposed for inclusion into system.
 - .2 Components will be returned for incorporation into work.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect photoelectric devices from nicks, scratches, and blemishes.
 - .3 Protect metal accessories and trim from being bent or damaged.
 - .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 PHOTOELECTRIC LIGHTING CONTROL

- .1 Photoelectric Lighting Controls: to CSA C22.1.
 - .1 Wall mounting or ceiling mounting .
 - .2 Capable of switching 1000 W of lighting at 120V.
 - .3 Voltage variation: plus or minus 10%.
 - .4 Temperature range: minus 40 degrees C to plus 40 degrees C.
 - .5 Rated for 5000 operations.
 - .6 Options:
 - .1 Fail-safe circuit completed when relay de-energized.
 - .2 Sensitivity adjustment.
 - .7 Switching time delay of 30 s.

PWGSC Project No. R.068431.001

.8 Colour coded leads: size 10 AWG, 460 mm long.

2.2 CONTACTOR

.1 Contactor: to CSA C22.1.

.1 Capable of switching multiple lamp circuits with total lighting load of 6000 W.

.2 Manual override.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for lighting control device 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 photoelectric controls in accordance with manufacturer's written instructions and to CSA C22.1.

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.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by lighting control devices installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

1.2 ACTION AND INFORMATIONAL 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 network lighting controls and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
 - .2 Indicate on drawings:
 - .1 Complete assembly.
 - .2 Contact surfaces.
 - .3 Construction features.
 - .4 Wiring diagrams.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .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 network lighting controls from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 OVERVIEW

- .1 Provide a complete low voltage lighting control system for Site Lighting as shown on the plans and specified herein.
- .2 Lighting control system shall utilize networking technology connecting relay panels, switches and sensors based upon a 2-wire data line providing both power and data to all field devices. The network shall be free topology; therefore a serial loop is not necessary to achieve maximum network distance. The system shall utilize a web server device complete with a touch screen located in a relay panel so that programming and viewing of status can be accomplished at the panel or by any PC connected to the same LAN or via the internet.
- .3 All relay panel interiors shall be pre-assembled complete with the necessary relays, transformers and devices. Relay panels that are wall mounted shall have interiors separate from enclosure so as to permit easy mounting, conduit installation and wire pull to enclosures. Enclosures mounted in the ceiling space are not required to have separate interiors.

2.2 RELAYS

- .1 Lighting control relays shall be mechanically latching and shall come complete with a manual ON/OFF switch. The mechanical switch shall continuously display the true state of the relay's internal contacts.
- .2 Single pole relays shall be rated and UL/CSA listed for 120, 277 and 347 VAC lighting loads at 20 amps and have a general, tungsten, standard and electronic ballast rating.
- .3 The relays shall have a label indicating the short circuit fault current rating. The relays shall have passed short circuit tests at 14,000 amperes.
- .4 Each lighting control relay shall be capable of controlling LED loads and have an inrush capability of 3000 amperes. Relays shall be complete with a 5-year Manufacturer's Limited Warranty.
- .5 Lighting control relays shall include captive screw terminals for both the line voltage and the low voltage connections. Switching the relay shall be accomplished with ONE signal wire and a common return. The signal wire shall be able to signal ON and OFF and shall carry status current that indicates if the relay is ON or OFF.

2.3 PRE-ASSEMBLED RELAY PANELS

- .1 Where indicated on the drawings, provide a factory pre-assembled relay panel. The panel's enclosure shall be for surface or flush installation, with a screw-on cover or a hinged door assembly as required.
- .2 The panel shall consist of a pre-assembled interior insert; UL/CSA approved with capacities for 36, 48 or 72 relays as required. Panel enclosure must be UL/CSA Approved.
- .3 Panel interior shall have the following pre-assembled and pre-wired:
 - .1 Suitable divider separating class 1 and class 2 compartments.

- .2 Control transformer, UL/CSA approved for class 2 circuits.
- .3 Low voltage relays as required by switched circuits.
- .4 Control devices as required.

2.4 DEVICE NETWORK CONTROLS

- .1 The Lighting Control Unit (LCU) shall be able to operate the local lighting control system on a stand-alone basis. For large installations that require multiple LCUs up to 25, all units must be able to operate on a stand-alone basis should they become disconnected from the network.
- .2 The LCU shall provide the following user interfaces for viewing and editing data:
 - .1 Built-in touch screen, for convenient access.
 - .2 Built-in web server, accessed via TCP/IP connection.
- .3 Each LCU shall provide the following standard lighting control functions:
 - .1 Program and control up to 252 relays and 252 dimmers.
 - .2 Link Outputs to switches and/or sensors to provide ON/OFF, Preset, or Dim Up/Down commands. In addition, functions such as Flick Warn, Time Out, Natural Daylight, Enable/Disable and Quiet Time can be associated with switches, sensors and relays and have these features scheduled by time-of-day or date.
 - .3 Be able to group Outputs and Inputs to facilitate various control schemes.
 - .4 Be able to program peripheral devices (switches, sensors, etc.) to function differently based on specific situations such as time-of-day, demand response status, user intervention, etc.
 - .5 Photo Sensor to provide Dusk-to-Dawn (switching) and/or Natural Daylight (dimming) with multiple set points to different groups.
 - .6 Astronomic Controls for Dusk-to-Dawn applications not requiring Photo Sensor.
 - .7 Provide Log Reports for diagnostic and run-time tracking purposes.
 - .8 Time Schedule types include: 7-day weekly scheduling, 365-day date specific and event scheduling.
- .4 The system shall have pre-defined logical applications for lighting controls.
 - .1 Astronomical Time Clock
 - .2 Natural Daylight (CLC) – Open Loop & Close Loop
 - .3 Exterior Threshold Photo Control
 - .4 Time Out (Unoccupied Mode)
 - .5 Quiet Mode
 - .6 Permanent Block
 - .7 Flick Warn
- .5 The system must have the ability to operate multiple items and modes with a single action and sequence them with time offsets.

- .6 Each LCU shall provide the following system functions:
 - .1 Demand response: connection via contact input.
 - .2 Accept configuration updates via USB port or Ethernet connection.
 - .3 Backup data via Ethernet or USB port.

2.5 DIMMING DRIVER CONTROL

- .1 The system shall be able to control industry standard 0-10VDC LED drivers.

2.6 GRAPHICS PACKAGE

- .1 In normal operation / manual command mode, the computer shall enable the viewing of one or more graphic drawings of the controlled building along with the status of each of the controlled sectors. Using the mouse or optional Touch Screen, the operator can view into various portions of the building and switch relays, groups, presets, and active modes. No special control code memorization shall be necessary.
- .2 The owner shall provide direction on colors and logos
- .3 The lighting symbols shall be established by the user through the graphic editor and shall change color in order to display the real time status of that particular relay or zone.
- .4 The Graphics shall be deployed on Global Web Server (GWS) and served up via a mobile app or desktop app.

2.7 WALL SWITCH

- .1 Switches shall connect to the lighting control network via a common 2-wire, non-polarized data line. Switches shall be configured and programmed to control one or more outputs in the lighting control system.
- .2 Switches shall have the capability to be configured by infrared setting unit that accesses programming fields of the switch without removing the switch from the wall box.
- .3 Switches are linked to a single output or a group of outputs.
- .4 Switches and Photo Sensors can be set to a common output address to permit multiple points of control for a single relay or dimming output.
- .5 Switches and Photo Sensors can be set to a common group address to permit multiple points of control for a group of outputs.
- .6 Each switch can be programmed for ON/OFF control of outputs of 0-10VDC LED drivers and/or preset control to set a specific lighting scene.
- .7 Switches, with LED indicators to indicate both ON and OFF output/group status, shall be available with 1, 2, 3, 4 or 8 single button switches per gang. Switch to fit standard Decora opening.
- .8 Switches and switch hardware shall mount to standard wall boxes.
- .9 Each switch shall provide a location for a label to identify function. The label shall be under a clear plastic cover and shall be field replaceable should the operation of the switch change. Permanently etched switches are not acceptable.

- .10 Adhere to the factory recommended wiring practices so that physical removal of any single switch shall still permit communication between relay panels and lighting control network.

2.8 DIMMER SWITCH

- .1 Dimmer switches shall be connected to the lighting control network via a 2-wire, non-polarized data line. Each switch shall be capable of raising or lowering light levels of individual or groups of lighting fixtures.
- .2 Switches shall include integral LED indication for light levels as well as a switch for ON/OFF control.
- .3 Dimmer switch can be programmed with infrared setting unit.

2.9 PHOTO SENSOR AND DAYLIGHT CONTROLS

- .1 Provide where required an Exterior Daylight Sensor capable of sensing from 0 to 65,000 lux (0 to 6500 fc) of direct light. The sensor shall derive both its power and data information from a data line.
- .2 The ambient light level shall be continuously monitored in lux by the sensor. The sensor shall broadcast to the network the existing light level when requested or when there is a change in detected light level.
- .3 Set point adjustments can be made via a touch screen or web server interface.
- .4 Each sensor can be programmed to provide ON/OFF control of relays, raise/lower LED drivers via a touch screen or web server interface.
- .5 One sensor shall permit different outputs to switch and/or control light levels as ambient light changes. Light levels shall be controlled by 'sensor only' or in combination with a time schedule or with a dimming switch.
- .6 It shall be possible to set a maximum light level which cannot be exceeded during Natural Daylight operations or for non-daylight controlled areas, a permanent or "tuned" light level to maximize energy savings.

2.10 INFRARED SETTING UNIT

- .1 Provide a Infrared Setting Unit to facilitate the following functions:
 - .1 Set input device and address
 - .2 Configure input device presets, group, and individual control
 - .3 Set local or global functionality

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for network lighting controls 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 system and components in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- .1 On completion of installation, manufacturer representative shall be notified to carry out site inspection and report any inconsistencies to the Departmental Representative. Corrections are to be implemented to comply with manufacturer's report.

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.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.

3.6 WIRING

- .1 For low voltage wiring, provide wire type as recommended by the manufacturer.
- .2 Adhere to manufacturer's recommendations as to maximum wire length and maximum quantity of relays per switch.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C9-02(R2007), Dry-Type Transformers.
 - .2 CAN/CSA-C802.2-06, Minimum Efficiency Values for Dry Type Transformers.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC GL1-3-1988, Transformer and Reactor Bushings.
- .3 National Electrical Manufacturers Association (NEMA)

1.3 REFERENCES

- .1 CSA International
 - .1 CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.

1.4 ACTION AND INFORMATIONAL 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 transformers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
 - .2 Indicate on drawings:
 - .1 Dimensions showing enclosure, mounting devices, terminals, taps, internal and external component layout.
 - .2 Technical data:
 - .1 kVA rating.
 - .2 Primary and secondary voltages.
 - .3 Frequency.
 - .4 Three phase.
 - .5 Polarity or angular displacement.
 - .6 Full load efficiency.
 - .7 Regulation at unity pf.

- .8 BIL.
- .9 Insulation type.
- .10 Sound rating.

- .4 Factory Test Submittals: submit standard factory test certificates of each transformer and type test of each transformer in accordance with CSA C9.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.
- .3 Operation and maintenance instructions to include:
 - .1 Tap changing.
 - .2 Recommended environmental conditions.
 - .3 Recommended periodic inspection and maintenance.
 - .4 Bushing replacement.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.7 EXTRA MATERIALS

- .1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 MATERIALS

- .1 Dry-type transformers: to CSA C9.
- .2 Bushings: to NEMA.

2.2 TRANSFORMER CHARACTERISTICS

- .1 Type: ANN.
- .2 Rating: 112.5 kVA, 3 phase, 60 Hz.

- .3 150 insulation system class, 150 degrees C temperature rise.
- .4 Impedance: 6 %.
- .5 Primary winding: 600V, delta, BIL 95 kV and grounded.
- .6 Secondary winding: 208 V, star, BIL 10 kV, four wire with neutral brought out and grounded.
- .7 No load and full load losses to exceed those indicated in CAN/CSA-C802.2.

2.3 ENCLOSURE

- .1 Fabricated from sheet steel with drip shield.
- .2 Bolted hinged removable panels for access to tap connections.
- .3 Conductor entry:
 - .1 Knockouts.
 - .2 Potheads.
 - .3 Junction boxes.
 - .4 Bushings.
 - .5 Clamping rings.
 - .6 Entry for cable.
- .4 Designed for floor.
- .5 Indoor, ventilated, self cooled type, complete with down slanted ventilation louvers. Temperature of exposed metal parts not to exceed 65 degrees C rise.
- .6 Outdoor, ventilated, self cooled type, CSA 3 enclosure.
- .7 Pad mounted type:
 - .1 Include conductor entry through bottom for underground distribution, with separate high and low voltage compartments divided by full length metal barrier.
 - .2 Ensure each compartment includes access door with concealed hinges.

2.4 VOLTAGE TAPS

- .1 2 taps, at 2.5% intervals below nominal.

2.5 TAP CHANGER

- .1 Bolted-link type.

2.6 WINDINGS

- .1 Primary and secondary coils:
 - .1 Copper.
 - .2 Open.
- .2 Coil and core assembly:
 - .1 Taps located at front of coils for accessibility.

2.7 ACCESSORIES

- .1 Wiring and terminal box for protective devices.
- .2 Grounding terminal: inside of enclosure.

2.8 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Equipment labels: nameplate size 7.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transformers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant 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 Consultant.

3.2 INSTALLATION

- .1 Locate, install and ground transformers in accordance with manufacturer's instructions.
- .2 Set and secure transformers in place, rigid plumb and square.
- .3 Connect primary terminals to high voltage circuit.
- .4 Connect secondary terminals to secondary feeder.
- .5 Use flexible conduit to make connections to transformer.
- .6 Energize transformers and check secondary no-load voltage.
- .7 Adjust primary taps as necessary to produce rated secondary voltage at no-load.
- .8 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.
- .9 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Energize transformers and apply incremental loads:
 - .1 0% for 4 hours.
 - .2 10% for next 1 hour.

- .3 25% for next 2 hours.
- .4 50% for next 3 hours.
- .5 Full load.
- .6 At each load change, check temperatures ambient

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.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 28 16.02 – Moulded Case Circuit Breakers.

1.2 REFERENCES

- .1 CSA Group
 - .1 CSA C22.2 No.31-10, Switchgear Assemblies.

1.3 ACTION AND INFORMATIONAL 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 service entrance board and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba, Canada.
 - .2 Indicate on drawings:
 - .1 Pad anchoring method and foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensioned layout of internal and front panel mounted components.
 - .3 Include time-current characteristic curves for circuit breakers and fuses.
- .4 Test and Evaluation Reports:
 - .1 Submit four (4) copies of certified test results.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for service entrance board for incorporation into manual.
- .3 Submit four (4) copies of operation and maintenance manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect service entrance board from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SERVICE ENTRANCE BOARD

- .1 Service Entrance Board: to CSA C22.2 No.31.
- .2 Rating: 347/600 V, 3 phase, 4 wire, 1600 A, short circuit current 42 kA (rms symmetrical).
- .3 Pad mount outdoor NEMA 3R weatherproof single unit with lockable doors.
- .4 Barrier metering section from adjoining Sections.
- .5 Provision for installation of power supply authority metering in barriered Section for remote meter.
- .6 Distribution section.
- .7 Hinged access panels with captive knurled thumb screws.
- .8 Bus bars and main connections: 99.3% copper.
- .9 Bus from load terminals of main breaker via metering section to main lugs of distribution section.
- .10 Cable from load terminals of main breaker to metering section and bus from metering section to lugs of distribution section.
- .11 Identify phases with colour coding.

2.2 MOULDED CASE CIRCUIT BREAKERS

- .1 Refer to Section 26 28 16.02 Moulded Case Circuit Breakers.

2.3 GROUNDING

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end for size 4/0 grounding cable.

2.4 GROUND FAULT UNIT

- .1 Refer to Section 26 28 16.02 Moulded Case Circuit Breakers.

2.5 POWER SUPPLY AUTHORITY METERING

- .1 Separate compartment and metal raceway for exclusive use of power supply authority metering.
- .2 Mounting accessories and wiring for metering are existing and to be transferred:
 - .1 Existing potential transformers.
 - .2 Existing current transformers.

2.6 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .1 Service entrance board exterior: gray.

2.7 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplates:
 - .1 White plate, black letters, size 7.
 - .2 Complete board labelled: "347/600V."
 - .3 Main disconnect labelled: "Main Breaker".
 - .4 Branch disconnects labelled: as indicated.

2.8 SOURCE QUALITY CONTROL

- .1 Departmental Representative to witness final factory tests.
- .2 Notify Departmental Representative in writing 5 days in advance that service entrance board is ready for testing.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for service entrance board 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 Locate service entrance board and fasten to pad.

- .2 Connect main secondary service to line terminals of main breaker.
- .3 Connect load terminals of distribution breaker's to feeders.
- .4 Check factory made connections for mechanical security and electrical continuity.
- .5 Run one grounding conductor 4/0 AWG bare copper in 25 mm conduit from ground bus to (4x) 3 meter ground rods spaced as per code.
- .6 Check [trip unit settings] [fuse sizes] against co-ordination study to ensure proper working and protection of components.

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.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.29-11, Panelboards and Enclosed Panelboards.

1.2 ACTION AND INFORMATIONAL 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 panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
 - .2 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect panelboards from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PANELBOARDS

- .1 250V panelboards: bus and breakers rated for 10 A symmetrical interrupting capacity or as indicated.
- .2 Panelboards: to CSA C22.2 No. 29-M1989.

- .3 CDP panels: to CSA C22.2 No. 29-M1989 and shall be manufactured to allow installation of two 200A frame breakers adjacent to each other – horizontally.
- .4 Panelboards shall be product of one manufacturer throughout project.
- .5 250V branch circuit panelboards: bus and breakers rated for 10 kA symmetrical interrupting capacity minimum or as indicated.
- .6 600V branch circuit panelboards: bus and breakers rated for 18kA symmetrical interrupting capacity, unless otherwise indicated.
- .7 250V CDP panelboards: bus and breakers rated for 25 kA symmetrical interrupting capacity, unless otherwise indicated. CDP panels shall be complete with doors.
- .8 600V CDP panelboards: bus and breakers rated for 22kA symmetrical interrupting capacity, unless otherwise indicated. CDP panels shall be complete with doors.
- .9 Sequence phase bussing such that circuit breakers shall be numbered vertically in consecutive order. Each breaker shall be identified by permanent number identification as to circuit number.
- .10 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .11 Two keys for each panelboard and key panelboards alike.
 - .1 Copper bus with full size neutral.
 - .2 Flush or surface-mounted tubs as shown.
 - .3 Finish trim and door baked grey enamel.
 - .4 CDP-type panelboards (breakers or fusible) shall be provided with a minimum of 6 – 200A, 3-pole, frame spaces.
 - .5 All panelboards and CDP's shall have “sprinklerproof” enclosures.
 - .6 Install circuit breakers in panelboards prior to shipment.

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.

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, mounted in plastic envelope at inside of panel door.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant 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 Consultant.

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00 - Rough Carpentry. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

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.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

- .1 CSA International
 - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55-M1986(R2008), Special Use Switches.
 - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

1.2 ACTION AND INFORMATIONAL 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 wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SWITCHES

- .1 20A, 120 V 227V 347 V, single pole, double pole, three-way, four-way switches to: CSA C22.2 No.55 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 Ivory toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads heating 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 Ivory 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 riveted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 Ivory urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 SPECIAL WIRING DEVICES

- .1 Special wiring devices:
 - .1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel flush type.

2.4 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof in use cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

2.6 HEAT TRACING CABLES

- .1 Heat/tracing cables for pipes to be self-limiting type rated at 10 watts/foot.
- .2 Voltage and length as indicated.
- .3 Provide cold lead connection kit and locate as indicated.
- .4 Electrical Contractor shall supply and install cables to manufacture's recommendations.
- .5 Provide GFI rated breaker complete with 30mA trip level
- .6 Acceptable manufacturer: Raychem.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices 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 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 as indicated in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .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 as indicated in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

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.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures Tri-national standard with UL 489, and NMX-J-266-ANCE-2010.

1.2 ACTION AND INFORMATIONAL 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 circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage with ampacity of 15A and over.
 - .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Departmental Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
 - .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.
 - .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 circuit breakers indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, ground-fault circuit-interrupters, fused circuit breakers, 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 degrees C ambient].
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Circuit breakers to have minimum 10 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.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for 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 circuit breakers as indicated.

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.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA Group
 - .1 CAN/CSA-C22.2 No.4-04(R2009), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
 - .2 CSA C22.2 No.39-13, Fuseholder Assemblies.

1.2 ACTION AND INFORMATIONAL 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 disconnect switches - fused and non-fused 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 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 disconnect switches - fused and non-fused from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible, Non-fusible, Horsepower rated disconnect switch in CSA enclosure heavy duty or NEMA 3R, to CAN/CSA-C22.2 No.4 size as indicated.
- .2 Provision for padlocking in on-off off switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.
- .5 Fuseholders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.
- .8 Heavy duty type.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for disconnect switches - fused and non-fused installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant .
 - .2 Inform Consultant 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 Consultant.

3.2 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

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.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 International Electrotechnical Commission (IEC)
 - .1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.

1.2 ACTION AND INFORMATIONAL 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.
- .3 Shop Drawings:
 - .1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province Manitoba, Canada.
 - .2 Provide shop drawings for each type of starter to indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout and components.
 - .4 Enclosure types.
 - .5 Wiring diagram.
 - .6 Interconnection diagrams.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motorstarter for incorporation into maintenance manual.
- .3 Extra Materials:
 - .1 Provide listed spare parts for each different size and type of starter.
 - .1 3 contacts, stationary.
 - .2 3 contacts, movable.
 - .3 1 contacts, auxiliary.
 - .4 1 control transformers.
 - .5 1 operating coil.
 - .6 2 fuses.
 - .7 10% indicating lamp bulbs used.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle 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.

Part 2 Products

2.1 MATERIALS

- .1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 MANUAL MOTOR STARTERS

- .1 Single Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.
 - .2 Three overload heaters, manual reset, trip indicating handle.
 - .3 Heavy duty type.
- .2 Accessories:
 - .1 Pushbutton switch: standard labelled as indicated.
 - .2 Indicating light: standard type and colour as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
 - .5 Heavy duty type.
- .2 Combination type starters to include circuit breaker with operating lever on outside of enclosure to control circuit breaker, and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
 - .1 Selector switches: standard labelled as indicated.
 - .2 Indicating lights: standard type and color as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 1 engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

1.2 REFERENCES

- .1 Canadian Environmental Protection Act (CEPA)
 - .1 CCME PN 1326-2008, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.
- .2 CSA International
 - .1 CSA-B139-09, Installation Code for Oil Burning Equipment.
 - .2 CAN3-Z299.3-85(R2006), Quality Assurance Program - Category 3.
- .3 Green Seal Environmental Standards (GSES)
 - .1 GS-11-2008, 2nd Edition, Paints and Coatings.
- .4 International Organization for Standardization (ISO)
 - .1 ISO 3046-1-2002, Reciprocating internal combustion engines - Performance - Part I: Declarations of power, fuel and lubricating oil consumptions, and test methods - Additional requirements for engines for general use.
 - .2 ISO 3046-4-1997, Reciprocating internal combustion engines - Performance - Part 4: Speed governing.
- .5 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA MG1-2006(R2007), Motors and Generators.
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
- .7 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
- .8 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S601-07, Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids.
 - .2 ULC-S603-00, Standard for Steel Underground Tanks for Flammable and Combustible Liquids.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:

- .1 Provide manufacturer's printed product literature, specifications and data sheets for generating units and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include following in accordance with Section 26 06 31 - Diesel Electric Generating Units Appendix A - Technical Data Form.
 - .1 Engine: make, model, rating and performance curves.
 - .2 Starter motor, make model.
 - .3 Generator: make, model and rating complete with generator saturation curves, heat damage curves, reactive capability and special data.
 - .4 Voltage regulator: make, model, type.
 - .5 Governor: type, model.
 - .6 Battery: make, type, voltage, capacity.
 - .7 Charger: make, model, input and output rating.
 - .8 Submit general outline drawing of complete assembly showing engine, radiator and generator mounting, exhaust, recirculating and intake air louvre arrangement, exhaust gas silencer and pipe arrangement, locations of fuel and lubricating oil filters, fuel supply and return line connections, lubricating oil drain valve, radiator and coolant drain valves, air cleaner, engine instrument panel, starting motor, power and control junction boxes, engine and generator mounting feet. Indicate on drawings:
 - .1 Horizontal and vertical dimensions.
 - .2 Minimum door opening required for moving unit.
 - .3 Head room required for removal of piston and connecting rod.
 - .4 Weight of engine, generator, baseplate, radiator and exhaust silencer.
 - .9 Identify exact locations and details where necessary of interconnecting services to permit final engineering by Departmental Representative.
 - .10 Baseplate construction details and materials.
 - .11 Transfer and bypass system: make, model, type.
 - .12 Outline and layout of panels.
 - .13 Schematic and wiring diagrams of engine, generator, control panel, automatic transfer and bypass panels complete with interconnecting wiring diagrams.
 - .14 Single line diagram showing all breakers, switches, metering and protective relays.
 - .15 Field wiring diagrams.
 - .16 Complete bill of materials, including manufacturer's name, catalogue numbers and capacity.
- .4 Lubricating oil system: where oil pump not provided, submit certification to Departmental Representative ensuring oil pump is not required and will not detract from service life of engine.
- .5 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba Canada.

- .6 Sustainable Design Submittals:
 - .1 Low-Emitting Materials: provide listing of coatings used in building, comply with VOC and chemical component limits or restriction requirements.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for diesel generating units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Provide in English for incorporation into instruction manuals as follows:
 - .1 Complete set of reviewed shop drawings.
 - .2 Factory test data of engine, generator, exciter, control logic, metering and other pertinent test data.
 - .3 Maintenance and operation bulletins for:
 - .1 Engine and Accessories.
 - .2 Generator.
 - .3 Voltage Regulator and Accessories.
 - .4 Exciter.
 - .5 Permanent magnet generator if installed.
 - .6 Battery charger.
 - .7 Speed Governor.
 - .8 Starting Motor.
 - .9 Batteries.
 - .10 Ventilating Equipment.
 - .11 Timers, Relays, Meters.
 - .12 Power Circuit Breakers.
 - .13 Controller, Contactors.
 - .14 Other Accessories.
 - .4 Submit original brochures; photocopies are not acceptable.
 - .1 Include technically relevant data.
 - .5 Complete sequence of system operation.
 - .6 Complete bill of materials including nameplate data of equipment and accessories.
- .3 Forward, two weeks prior to factory tests, one copy of instruction manual for each unit of different ratings to Departmental Representative.
- .4 Forward, within two weeks after factory tests, three copies of instruction manuals, with updated drawings, for each unit of different ratings, to Departmental Representative.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Provide conclusive evidence that Canadian distributor has been established and will stock in Canada spare parts likely to be required during normal life of engine.
- .3 Provide conclusive evidence that Canadian distributor has been established and will stock in Canada spare parts likely to be required during normal life of engine.
- .4 Tools:
 - .1 Supply suitable engine barring device and battery manufacturer's standard set of tools for battery service.
 - .1 Battery service tools to include hydrometer, one plastic bottle for topping up purposes and one insulated battery terminal wrench.
 - .2 Provide complete set of specialized tools required for proper care, adjustment and maintenance of equipment supplied.
 - .3 Where metric size nuts and bolts are used, provide one set of sockets complete with ratchet handle and set of combination wrenches, to fit sizes used.

1.6 QUALITY ASSURANCE

- .1 Do work to CAN3-Z299.3.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
 - .2 Prepare, crate and protect equipment against shipping and storage damage.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Provide automatic, unattended, emergency power supply system consisting of:
 - .1 Liquid cooled low voltage diesel electric generating unit with control panel, transfer switch and enclosure.
 - .2 Accessories and equipment specified in this specification.
- .2 Provide design, fabrication, testing, transportation, demonstration and equipment warranty.

2.2 DESIGN CRITERIA

- .1 Design equipment to meet following requirements:
 - .1 Total load: 600 kW.
 - .2 Voltage: 357/600 V.
 - .3 Frequency: 60 Hz.

- .4 3 Phase/4 Wire.
- .5 Power factor: 0.8.
- .6 Load harmonic content: 20% THD.
- .7 Maximum rotational speed: 1800 rpm.
- .8 Duty rating: full load continuous plus 10% overload for 1 hour in every 12 hours period.
- .9 Performance: automatic.
- .10 Elevation above sea level: 152 m.
- .11 Ambient temperature: 40 degree C.
- .12 Relative humidity: 60%.
- .2 Design unit capable of starting, attaining settled voltage and frequency limits and accepting full rated load with voltage and frequency settling to specified steady state bands, within 15 seconds for any temperature between 0 degree C to 40 degrees C.
- .3 Use engine manufacturer's standard, published continuous (prime) horsepower rating in assessing engine capacity and derate this rating for specified conditions and engine driven accessories in accordance with ISO 3046-1.
- .4 Description of generating set operation:
 - .1 Automatic starting on abnormal or loss of normal voltage: voltage sensing relays to sense three phases of hydro supply.
 - .1 If voltage on any one phase should drop below preset limits (adjustable) for adjustable period of time, close engine start contact and start engine.
 - .2 When emergency supply has reached settled voltage and frequency preset limits (adjustable) transfer switch will transfer load to emergency supply.
 - .3 Continue to supply load until hydro supply returns or set is shut down manually or under failure conditions.
 - .4 On hydro restoration, confirmed by three phase sensing of voltage above adjustable preset, for time period in excess of three minutes (adjustable), transfer switch will transfer load to hydro supply.
 - .5 Adjustable time delay relay to allow engine to run unloaded to cool down and subsequently to shut down, ready for next cycle.
 - .6 Equip engine with key switch with following positions: auto-off-crank-start, key removable in auto position only.
 - .7 Automatic shut down on:
 - .1 Overcranking.
 - .2 Overspeed.
 - .3 High engine temperature.
 - .4 Low lubricating oil pressure.
 - .5 Over and under frequency.
 - .6 Emergency breaker failure.
 - .7 Electrical fault lock-out on short circuit and generator over and under voltage.

2.3 ASSEMBLY

- .1 Provide items as follows plus other items necessary to make unit complete:
 - .1 Diesel engine.
 - .2 Diesel engine accessories.
 - .3 Baseplate and drip pan.
 - .4 Vibration isolators.
 - .5 Governor.
 - .6 Engine exhaust system.
 - .7 Engine cooling system.
 - .8 Engine ventilating system.
 - .9 Starting motors.
 - .10 Batteries and rack.
 - .11 Battery charger.
 - .12 Generator and exciter.
 - .13 Voltage regulator and accessories.
 - .14 Control panel and transfer switch.
 - .15 Spares and accessories.
 - .16 Fuel tank.

2.4 MOUNTING

- .1 Connect engine flywheel housing rigidly to generator stator housing with SAE adapter.
 - .1 Mount unit on common, heavy duty fabricated steel baseplate.
- .2 Baseplate: rigid material to maintain alignment of engine-generator shafts and frames under shipping, installation and service conditions.
- .3 Install machine engine-generator feet and baseplate sole plates parallel and true.
 - .1 Shims: steel type, installed under generator feet.
- .4 Support baseplate on spring type isolating fixtures from welded side brackets located to support bottom of baseplate 25 mm above supporting floor.
 - .1 Isolators: cast iron housings, complete with levelling bolts, adjustable oil proof snubbers and minimum 6 mm sound pads.
 - .2 Isolation efficiency 95% minimum.
- .5 Determine quantity and location of isolators.
 - .1 Locate each isolator to carry equal proportion of weight and that pressure exerted on floor by each isolator does not exceed 345 kPa.
- .6 Ship isolators loose for installation at project site.

2.5 DIESEL ENGINE

- .1 Full diesel, heavy duty, cold start, liquid cooled, vertical in-line or vee, and current manufacture of a type and size that has been service as a prime mover for electric power generation for not less than two years.
 - .1 Turbo supercharged engine acceptable providing brake mean effective pressure (BMEP) at rated output does not exceed 1800 kPa (225 psi).
 - .2 Mechanically driven superchargers not acceptable.
- .2 Engine: minimum of four (4) cylinders.
- .3 Engine with auxiliary starting aids (i.e., glow plug assist start) not acceptable.
- .4 Equip engine air intakes with dry type heavy duty air cleaners located close to inlet manifold.
 - .1 Cleaner element: directly replaceable with elements of Canadian manufacture.
- .5 Provide engine wiring in liquid-tight conduit and fittings with insulated bushings.
 - .1 Use stranded, minimum No.14 AWG, TEW 105 degree C and coloured coded wires .
 - .2 Terminate wiring with coded, insulated terminals flanged fork type. Terminal blocks heavy duty, screw type.
 - .3 Wire markers of slip on oil proof type.
 - .4 Junction boxes on unit of liquid-tight type..
 - .5 Maximum of two wires per terminal block.
- .6 Provide high quality lubricating oil pressure gauge, lubricating oil temperature gauge, tachometer, coolant temperature gauge, exhaust pyrometer and other standard gauges and instruments.
 - .1 Calibrate and scale gauges and instrument in both metric and imperial units and symbols.
 - .2 Mount oil temperature sensors on engine full flow pressure line.
 - .3 Hoses or tubing for gauges: high pressure reinforced type.
- .7 Mount unit accessories, including gauges, instruments, and protective sensors, to isolate or dampen vibrations.
- .8 Dynamically balance complete engine-flywheel generator arrangement after assembly.
 - .1 Torsional or other vibration tolerance within 10% above or below rated speed of unit, when operating unloaded or connected to any load within its rating.
 - .2 Cyclic irregularity: 1/250 maximum.
- .9 Provide engine flywheel with graduated marking around its periphery to facilitate fuel injection and valve timing.
- .10 Provide removable wet type cylinder liners.
 - .1 Furnish cylinder head with removable valve seat insert and guides.
- .11 Provide personnel safety guards for exposed moving parts and exhaust manifolds.

- .1 Provide platform for servicing upper part of engine where applicable.
- .12 Engine control panel complete with:
 - .1 Lubricating oil pressure gauge.
 - .2 Lubricating oil temperature gauge.
 - .3 Coolant temperature gauge.
 - .4 Low coolant level gauge.
 - .5 Engine switch auto-off-crank-start selector switch and crank pushbutton.
 - .6 D.C. main power supply circuit breaker.
 - .7 Terminal blocks for connection to D.C. power supply, engine monitoring and shutdown device.
 - .8 Provide low oil pressure, high coolant temperature, low coolant level and overspeed protection to shut down engine on manual operation.

2.6 COOLING AND VENTILATING SYSTEM

- .1 Provide complete cooling and ventilating system for unit.
- .2 Thermostatically control system and maintain coolant, ethylene glycol, within engine manufacturer's tolerance, 88 degree C with unit operating at rated load under specified conditions. Cooling system engine mounted radiator type.
 - .1 Design and supply complete ventilating system where engine mounted radiator is required.
 - .1 Radiator cooling fan to be pusher type, minimum two belt drive with belt adjuster.
 - .2 Fan, pulley and belt with removable protective cage.
- .3 Provide drain valves for draining coolant from engine block and radiator.
 - .1 Drain coolant conveniently into large container through flexible extensions.
 - .2 Dripping valves or leaking connections will not be permitted.
- .4 Ventilation system: complete with canvas connections, mounting hardware, modulating damper motors, dampers, inlet and outlet hoods, bird/insect/screen, manual potentiometer, damper linkages, low voltage transformer, thermostat, fan motor.
 - .1 Provide positive seal, zero heat loss louvers. Air filter 25 mm deep disposable type with fiberglass filter media and initial static pressure drop not to exceed 25 Pa based on face velocity of 2.54 m/s.
- .5 Ventilating system operation as follows:
 - .1 Air inlet and outlet damper closed when engine not running.
 - .2 On engine start, air inlet damper to open.
 - .3 Inlet damper minimum opening to be set by manual potentiometer.
 - .4 Thermostat to modulate inlet and outlet dampers to maintain set room temperature.
 - .5 Fan to start when inlet louvres 90% open (adjustable).

2.7 LUBRICATION SYSTEM

- .1 Provide full pressure lubricating system complete with duplex filters and oil cooler.
- .2 Oil pump: engine driven gear type complete with strainer.
- .3 Equip filters with automatic by-pass valve and full flow filter elements conveniently located for servicing and directly replaceable with elements of Canadian manufacture.
 - .1 Cooler to have sufficient capacity to maintain oil temperature within engine manufacturer's tolerances with unit operating at rated load under conditions specified.
- .4 Equip engine oil sump with oil drain pipe, gate valve and pipe cap.
 - .1 Permit complete drainage in a convenient manner.
- .5 Ensure unit is able to start and assume full rated load within the specified 15 second time period when, operational requirements are such that unit may lay idle for periods up to one month.
 - .1 Provide electrical motor driven, integrally mounted, gear type oil priming pump with interval timer and breaker type combination starter.
 - .2 Starter mounted in control panel.
 - .3 Lubrication oil pressure switch to stop priming pump when engine is running.
- .6 Metallic oil hoses: steel reinforced rubber type with crimped or swaged end fittings.

2.8 FUEL SYSTEM

- .1 Provide complete fuel system including fuel lift pump and duplex filters in accordance with CSA-B139.
 - .1 Filter elements to be directly replaceable with elements of Canadian manufacture.
- .2 Bring fuel supply and return lines to extreme forward part of baseplate with drop ear elbows.
 - .1 Connect other end of each elbow with 1 m of flexible neoprene hose.
- .3 Provide, loose, approximately 9 m of copper tubing and necessary fittings including two SAE flare union nuts (long) with half unions for connecting 12 mm gate valves.
- .4 Non-metallic fuel hoses: steel reinforced rubber type with crimped or swaged end fittings.

2.9 EXHAUST SYSTEM

- .1 Provide complete exhaust system including heavy duty critical type silencer with condensate drain, plug and flanged couplings; stainless steel, corrugated expansion joints, length to suit, to absorb both vertical and horizontal expansion; flanges, bolts, gaskets, adjustable hangers and pipe and pipe-thimble to permit projection of pipe 1.0 m beyond wall.
 - .1 Exhaust tail pipe end at 45 degree angle and terminate in air filter. Insulate interior exhaust piping and silencer .

- .2 Arrange exhaust system to suit openings.
 - .1 Where schedule of dimensions does not indicate location of opening, arrange exhaust run best suited to engine.
- .3 Provide exhaust pyrometers located on common exhaust manifold or two pyrometers on separate manifolds.
 - .1 Pyrometer range to include temperature at 110% load.

2.10 JACKET COOLANT HEATER

- .1 Provide engine jacket coolant heater complete with 20 degree C to 60 degree C adjustable immersion type thermostat.
 - .1 Size heater to maintain coolant at 40 degree C in an ambient temperature of 0 degree C.
- .2 Obtain circulation of heated coolant on thermosyphon principle.
 - .1 However, if this does not provide sufficient circulation to avoid hot spots in system, provide electrical motor driven circulating pump to operate automatically when heater is energized.
 - .2 Motor: 120 V single phase splash-proof type complete with breaker type combination starter.
 - .3 Starter mounted in control panel.

2.11 SPEED GOVERNOR

- .1 Provide full electronic governor with speed changer and dry type actuator.
 - .1 Governing system: in accordance with ISO 3046-4.
- .2 Governor with following features:
 - .1 Ten turn locking type manual speed adjustment.
 - .2 Speed regulation, steady state, no-load to full load and vice versa: +/-0.25%.
 - .3 Transient peak, no-load to full-load and vice versa +/-10%.
 - .4 Recovery time to steady state condition on application of full load from no load not to exceed 3 seconds.
 - .5 Frequency: externally adjustable from zero to 5% while engine is running.
 - .6 Class A accuracy.

2.12 STARTING SYSTEM

- .1 Provide complete starting system including cranking starting motor, batteries, battery stand, heavy-duty battery cables and battery charger.
- .2 Provide positive engaging type cranking motor.
 - .1 Cranking motor and flywheel ring gear arrangements which may permit tooth to tooth abutment not acceptable.

- .3 Provide lead acid battery with sufficient capacity in ambient room temperature of 0 degree C to crank unit at engine manufacturer's recommended cranking starting speed for period of 3 minutes.
 - .1 Voltage measured at starting motor terminals at end of 3 minutes cranking, with cranking current flowing, not less than 1.75 V per cell.
 - .2 Size battery to suit engine and battery manufacturer's published data.
 - .3 Batteries: dry charged, specific gravity of electrolyte 1.220 when fully charged at 27 degree C.
 - .4 Battery termination: bolt-on or study type.
 - .5 Protect terminals and exposed electrical connections from accidental short circuit by falling conductive objects on battery.
- .4 Provide battery stand coated with acid resistant paint and fabricated from angle irons with 20 mm plywood bottom and heavy duty casters for ease of movement.
- .5 Provide battery charger with 120 volt AC input and output equal to 1.20 of ampere-hour capacity of battery based on 8 hour rate.
 - .1 Output voltage ripple: 3% or less.
 - .2 Provide AC input circuit breaker and 24 hours terminating equalizer timer with approximately 4 m of connecting cord and permanent connectors for connecting to battery terminals.
 - .3 Provide 5 spare fuses inside charger panel.
 - .4 Charger: CSA approved.
- .6 Provide necessary heavy duty, maintenance-free battery cables and connectors.
 - .1 Select cable wire size on the basis of allowing not more than 5% voltage drop at time of peak load.
 - .2 Cable length sufficient to allow battery location on either side of engine.
- .7 Fit turbocharged engines with one spring actuated, two stage accumulator per turbocharger to automatically provide pre-start and post run lubrication to turbochargers.

2.13 GENERATOR

- .1 Provide generator, drip proof, single bearing and close coupled to engine with SAE housing: to NEMA MG 1.
 - .1 Generator: full amortisseur winding, direct connected brushless exciter with easily removable bolt-on diodes with surge protection.
- .2 Maximum deviation of open circuit terminal voltage waveform not to exceed 5%.
- .3 Provide permanent magnet generator (PMG) for generator short circuit sustaining capability not less than 2.4 times rated current.
- .4 Generator winding insulation: Class F; winding temperature rise not to exceed 80 degree C as measured by resistance in ambient temperature of 40 degree C.
- .5 Identify generator windings with metal tags.

- .1 Bring windings to insulated terminals in metal junction box mounted on side or top of generator.
- .2 Size junction box to permit mounting of engine and generator low voltage controls and wiring terminals blocks.
- .3 Provide barrier in junction box to separate low and high voltage wiring.
- .6 Provide voltage regulation system complete with auto/manual control module.
 - .1 Voltage regulator: capable of withstanding continuous vibration, 15 G shock and temperature up to 50 degree C while maintaining accuracy to plus/minus 1%.
- .7 Steady-state voltage regulation not to exceed 1%.
 - .1 Transient voltage regulation, when full load is applied or removed, not to exceed 10% when measured by oscilloscope or high speed strip chart recorder with recovery time to steady-state less than 3 seconds.
- .8 Design equipment to minimize radio frequency interference (RFI) under operating conditions.
 - .1 Balanced telephone influence factor (TIF) to: NEMA MG 1.

2.14 PANEL - GENERAL

- .1 Panel: indoor, free-standing, dead front, metal-enclosed steel construction complete with lifting eye bolts.
 - .1 Doors: formed edges, reinforced by stiffeners and complete with lockable handles.
- .2 Design and construct panel to withstand strains, jars, vibrations and other conditions incident to shipping, storage, installation and service.
- .3 Panel CSA certified. Mount a nameplate bearing CSA monogram in a prominent position on panel.
- .4 Identify instruments and controls with lamacoid or metal engraved nameplates fastened by rivets or screws for permanent identification.
 - .1 Identify door mounted items with nameplates.
 - .2 Attach nameplates to removable items such as relays and wireway covers.
- .5 Provide panel with bolted rear covers.
- .6 Factory wire panel completely. Use stranded, minimum No.14AWG, TEW 105 degree C and coloured for control wiring. Use No.10AWG for CT secondary connections:
 - .1 Blue - DC control.
 - .2 Red - AC control.
 - .3 Black - PT secondary connections.
 - .4 Orange - CT secondary connections.
 - .5 Green - non-current carrying ground.
 - .6 White - current carrying ground.
 - .7 Yellow - interlocks.

- .8 Brown - generator excitation system.
- .7 Code wiring at each wire end with permanent, non-aging slip on markers.
 - .1 Support and run wiring neatly.
 - .2 Protect wiring from mechanical damage by grommets and shields.
- .8 Code terminal blocks, clamp type, serrated for positive grip and of tough, non-brittle, unbreakable nylon, size 3,453/0 or equivalent.
 - .1 For current transformer secondary circuits, provide terminal blocks of dual connector type.
 - .2 Provide test block for current transformer secondary connections.
- .9 Provide door detent mechanism to maintain hinged door at open position.
- .10 Supply loose 2 sets of wiring markers for each external wiring connection.
 - .1 Place markers in plastic bag and secured inside panel.
- .11 Use wiring duct for interconnection within panel.
- .12 Direct inter-panel connection not permitted, use terminal blocks.

2.15 CONTROL PANEL

- .1 Provide control panel for controlling engine generator unit.
- .2 Provide hinged front door and internal sub-panel.
- .3 Provide control panel, transfer switch and by-pass panel.
- .4 Provide instrumentation, switching and control as listed in bill of material.
 - .1 Electrical connection of components shown in solid lines on drawing.
- .5 Panel dimensions and layout.
- .6 Mount terminal blocks on common mounting strips for interconnection wiring between the following:
 - .1 Sub-panel and external wiring from diesel generator unit circuits.
- .7 Provide 1 cm x 4 cm horizontal copper ground bus for whole length of enclosure, and two ground lugs; one at each end.
 - .1 Lug: capable of accepting grounding conductor of range from No. 8 to No. 2/0 AWG.
- .8 Terminal blocks: CSA approved, clamp type, serrated for positive grip and of tough, non-brittle unbreakable nylon material; maximum two wires per terminal block.
 - .1 Use factory made terminal block jumpers wherever necessary.
- .9 Provide circuit breakers for equipment protection: use fuses where breakers are not applicable.
- .10 Provide top and bottom entry for power and control cables. Provide removable bottom plate 0.45 m x 0.15 m.

2.16 ENGINE-GENERATOR TRANSFORMER CONTROLLER

- .1 Provide solid state controller complete with control and power modules for sensing, timing, logic and instrumentation to control diesel generator set and automatic transfer system.
- .2 Controller to include following features:
 - .1 Five position function selection switch - Reset, Off, Auto, Test No. Load, Test Full Load.
 - .2 Inverse time-voltage sensors for monitoring normal and emergency voltage and frequency.
 - .3 Controls necessary to provide system operation.
 - .4 Annunciator lights for following:
 - .1 Overcrank.
 - .2 Low Oil Pressure.
 - .3 High Coolant Temperature.
 - .4 Low Coolant Level.
 - .5 Overspeed.
 - .6 Frequency Limit.
 - .7 Voltage Limit.
 - .8 Contactor Failure.
 - .9 Fire Alarm.
- .3 Function selection to operate as follows:
 - .1 Reset: to reset the engine-generator set after it has been shut down on protective device.
 - .2 Off: the engine-generator set is shut off.
 - .3 Auto: provides automatic operation of engine generator set and transfer system.
 - .4 Test No. Load: exercises engine generator set without load. In event normal power fails during this mode, transfer system will operate to connect load to set.
 - .5 Test Full Load: simulates normal power failure and runs engine generator set under load. If emergency power fails under this mode, transfer system to operate to re-store normal power to load.
- .4 Provide sufficiently sized capacitors on power input terminals to controller to maintain supply voltage, especially on D.C. power input during engine start.
- .5 Controller to include following time delays and adjustments.
 - .1 Crank delay preset at 3-20 sec.
 - .2 Restart preset at 15 sec.
 - .3 Bypass preset at 10 sec.
 - .4 Anticipated fail preset at minimum time setting.
 - .5 Engine start preset at 2 sec.
 - .6 EM - normal preset at 20 sec.
 - .7 Dead bus preset at 2 sec.

- .8 Cool down preset at 5 min.
- .6 Equip controller with cycle crank provision to crank engine three time with adjustable rest delay of 3-30 seconds preset at 5 seconds.
- .7 Equip controller with provision to reset controller and to select Category II operation from remote location.
 - .1 Category II operation to operate emergency supply as main source to load and use normal source as standby.
- .8 Provide controller with following features:
 - .1 Front panel programming and display using keypad and to allow changing of parameters, operating configuration, status, and values.
 - .2 Security access code to prevent unauthorized changes.
 - .3 Self diagnostics, continually operating in the background, to ensure proper operation of microprocessor.
 - .4 Non-volatile memory to store operating logic, configuration and set points upon total loss of power.
 - .5 Sufficient internal power to maintain control outputs and operating sequence upon loss of DC supply from working battery.
 - .6 Isolation of inputs and outputs to ensure correct operation and no damage in event of transient voltages.
 - .7 Operation counter for number of diesel starts (non-resettable).
 - .8 Operating temperature 0-50 degree C.

2.17 SUB BASE

- .1 BASE DESIGN
 - .1 The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment is maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall withstand and mitigate the effects of synchronous vibration of the engine and generator. The base shall be provided with suitable holes for anchor bolts.
- .2 VIBRATION ISOLATION: NEOPRENE PAD
 - .1 Pad Vibration between engine generator set and foundation (standard) or sub base fuel tank.
- .3 FUEL STORAGE
 - .1 SUB BASE TANK: 36 hours of operation.
 - .2 A Sub-Base skid mounted fuel tank will be supplied.
 - .1 Sub Base Tank Construction
 - .1 Sub base tank shall be Tramont or approved equivalent.
 - .2 Be constructed in accordance with Underwriters Laboratories Standard UL-142.

- .3 Be constructed in accordance with Flammable and Combustible Liquids Code, NFPA 30; The Standard for Installation and use of Stationary Combustible Engine and Gas Turbines, NFPA 37; and The Standard for Emergency and Standby Power Systems, NFPA 110.
- .4 Be rectangular in shape.
- .5 Include reinforced steel box channel for generator support, with load rating of 5,000 lbs. per gen-set mounting hole location. Full height gussets shall be provided at gen-set mounting holes.
- .6 Be pressure washed with an iron phosphate solution. Interior shall be coated with a solvent-based film rust preventative, providing inter-operational protection.
- .7 Be shipped with a certificate of Structural/Mechanical Integrity, certifying that it has met standards through rigorous testing and has demonstrated specified capabilities.
- .2 Sub Base Tank Testing
 - .1 Primary tank sections shall be pressurized at 3-5 psi and leak-checked to ensure integrity of sub base weld seams per UL-142 standards. Containment basin shall be leak-checked by means of weld penetrant and ultraviolet light.
- .3 Sub Base Tank Fittings
 - .1 The sub base tank shall include the following fittings:
 - .1 Appropriately sized NPT fuel supply;
 - .2 Fuel return fitting;
 - .3 1-1/4 inch NPT for normal vent;
 - .4 NPT for emergency vent, sized as appropriate;
 - .5 2 inch NPT for manual fill;
 - .6 NPT for level gauge, sized as appropriate;
 - .7 3/8 inch NPT basin drain - tank drain if single wall;
 - .8 2 inch NPT for level alarm; and
 - .9 NPT fitting for leak detection alarm.
- .4 Fuel Level Gauge
 - .1 The sub base tank shall include a direct-reading fuel level gauge.
- .5 Fuel Containment Basin
 - .1 Sub base tank shall include a welded steel containment basin, sized at a minimum of 110% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.
- .6 Leak Detection System
 - .1 A fuel containment basin leak detector switch shall be provided.
- .7 Sub Base Tank Venting
 - .1 Normal venting:

- .1 Normal venting shall be sized in accordance with the American Petroleum Institute Standard No. 2000, for venting atmospheric and low pressure storage tanks.
 - .2 Tank shall be provided with atmospheric - normal - vent cap with screen.
 - .3 Normal venting shall be sized as follows:
 - .1 1-1/4 inches NPT for tanks through 2,499 gallons
 - .2 1-1/2 inches NPT for 2,500 to 3,000 gallons
 - .3 2 inches NPT for 3,001 to 10,000 gallons
 - .4 Emergency venting:
 - .1 The emergency vent NPT fitting shall be sized to accommodate the total capacity of both normal and emergency vents, and is not less than that derived from NFPA 30, Table 2-8, based on wetted surface area of the tank - calculated based on 100% of primary tank.
 - .2 A zinc-plated emergency pressure relief vent cap shall be furnished. The vent shall be spring-pressure operated. Opening pressure shall be 0.5 psig; full opening pressure shall be 2.5 psig. Limits shall be marked on top of each vent.
 - .3 A second emergency vent fitting shall be provided for the secondary containment portion of the tank if applicable.
- .4 TRAILER
- .1 No trailer will be supplied.

2.18 WINTERIZED SOUND ATTENUATED ENCLOSURE

- .1 Equipped with a tight fitting weather proof enclosure suitable for location in outdoor extreme cold climates.
- .2 The enclosures shall allow the generator set to operate at full load in an ambient of -40°C to +45°C with no additional de-rating of the electrical output
- .3 Enclosure is to be fully sealed and insulated suited for extreme winter conditions. The interior temperature must NOT fall below +10°C at any time as per CSA C282-2009.
- .4 Enclosure shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options.
- .5 Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required.
- .6 Access to the controller and main line circuit breaker must meet the requirements of the Canadian Electric Code.

- .7 All enclosures are to be constructed from high strength, low alloy steel, aluminum or galvanized steel.
- .8 Doors shall be equipped with lockable latches. Locks must be keyed alike.
- .9 Doors must be hinged with stainless steel hinges and hardware is to be removable.
- .10 Seal all openings around perimeter of skid base.
- .11 Enclosure to have a fade, scratch and corrosion resistant powder baked finish.
- .12 Provide junction boxes inside enclosure for electrical hook-up of block heater, space heater, battery heater, damper motors, lights, receptacles, etc.
- .13 Provide a 60 amp 120/240V 1Ø 3W electrical distribution breaker panel inside the enclosure for connection of all prewired enclosure electrical items. (Space heater, block heater, battery heater, battery charger, lights, receptacles, etc.)
- .14 The entire enclosure including doors must be with minimum 25 mm thick insulation. Seal all gaps to eliminate entrance of snow. Insulation must meet UL 94 HF 1 flammability classification.
- .15 Incandescent vapour tight AC lights to provide illumination in control section of enclosure.
- .16 All intake and exhaust openings must be sealed air tight with motorized dampers. Gravity dampers are NOT acceptable. Dampers are to operate with generator power to open, and spring return to close.
- .17 90° (degree) snow hoods are required over all motorized damper assemblies to prevent the accumulation of snow and ice on the damper blades.
- .18 Provide a duct between the radiator air discharge and enclosure air outlet to prevent re-circulation of hot air.
- .19 Supply and Mount silencer and complete exhaust system inside the enclosure. Only the exhaust tail pipe is to extend outside the enclosure.
- .20 Overall sound attenuation to not to exceed 68 dB(a) @ 7m.
- .21 Install a convenience 120 volt GFI receptacle inside the enclosure.
- .22 All of the above to be installed on the generator before delivery to site, to allow for a factory witnessed test at the generator suppliers' local facility.

2.19 SIGNS

- .1 Provide at front top of each panel and on each generator junction box, lamacoid or metal engraved identification nameplate.
 - .1 Provide nameplates with letter and number identification designation to be given at time of acceptance tests.
- .2 Provide and attach to unit in prominent location, bilingual warning sign.
- .3 Where metric tools are required to service engine-generator unit, provide bilingual warning sign.

2.20 FINISHES

- .1 In accordance with manufacturer's recommendations for surface conditions.

2.21 QUALITY OF WORK

- .1 Manufacture and construct equipment free from blemishes, defects, burrs and sharp edges; accuracy of dimensions and marking of parts and assemblies; thoroughness of welding, brazing, painting and wiring, alignment of parts and tightness of assembly screws and bolts.

2.22 QUALITY CONTROL

- .1 General: before acceptance, assemble and set up the unit, complete with specified equipment, for tests at the supplier's plant in accordance with Section 26 32 13.07 - Diesel Electric Generating Units Appendix B Factory Test Section 01 45 00 - Quality Control.
 - .1 Ensure tests are witnessed by Departmental Representative on mutually agreed date.
 - .2 Provide suitable test area with adjustable loading facilities.
 - .3 Ensure that engine has run in sufficiently prior to load test, test forms completed, system debugged and recorders connected.
- .2 Product examination: complete mechanical and electrical examination to determine compliance with specification and drawings with respect to materials, workmanship, dimensions and marking.
- .3 Non-operational tests and checks: perform following test and checks before starting the unit:
 - .1 Shaft alignment, end float, angular and parallel.
 - .2 Cold resistance of generator windings.
 - .3 Belt tensioning.
 - .4 Equipment grounds.
 - .5 Electrical wiring.
 - .6 All grease lubricating points.
 - .7 Personnel safety guards.
 - .8 Air cleaner.
 - .9 Coolant.
 - .10 Lubricating oil type and level.
 - .11 Type of fuel.
 - .12 Vibration isolator adjustment.
 - .13 Temperature and pressure sensors.
 - .14 Engine exhaust system.
 - .15 Tools.
- .4 Operation test and check: on completion of non-operational tests and checks, start unit cold. Provide multi-channel recorder and record following :

- .1 Time for unit to start and reach settled voltage and frequency.
- .2 Time from initiation of start to full load application, with voltage and frequency settled.
- .3 Voltage and frequency transient and steady state limits for full load to no load, 3/4 load to no load, load to no load, 1/4 load to no load and vice versa. Measure machine vibration levels under the same load conditions, in accordance with Section 26 32 13.07 - Diesel Electric Generating Units Appendix B Factory Test.
- .4 Record battery voltage drop during cranking.
- .5 Protection and control demonstration: on completion of operation test and check, demonstrate following:
 - .1 Overheat protection.
 - .2 Low oil pressure protection.
 - .3 Cranking cut out.
 - .4 Overcrank protection (3 tries).
 - .5 Overspeed protection.
 - .6 Under and over frequency.
 - .7 Under and over voltage.
 - .8 Electrical fault protection:
 - .1 Failure to close breaker.
 - .2 Failure to build up voltage.
 - .3 Generator short circuit and overcurrent.
 - .9 All control functions.
- .6 Load tests: load test the unit for 24 hours at full rated load and further 1 hour at 110% rated load in ambient room temperature of 40 degree C. Take following data at start of load test and every one hour interval thereafter:
 - .1 Frequency.
 - .2 Voltage.
 - .3 Current.
 - .4 Kilowatts.
 - .5 Generator winding temperature.
 - .6 Generator frame temperature.
 - .7 Engine coolant temperature.
 - .8 Oil temperature and pressure.
 - .9 Manifold pressure.
 - .10 Ambient room temperature.
 - .11 Generator cooling air outlet temperature.
 - .12 Exciter field current and voltage.
 - .13 Vibration displacement.
 - .14 Ambient air temperature inside panel with doors closed.

- .7 Miscellaneous: provide accurate means for determining fuel and lubricating oil consumption.
 - .1 Provide strip chart recorders for monitoring frequency, voltage and load.
 - .2 Provide recorder with ability to select speeds to allow accurate measurement of voltage, frequency and time during tests.
 - .3 Calibrate recorder by the recorder manufacturer (or designated representative) within three months of factory testing.
- .8 Interpretation of ambient room temperature: consider ambient room temperature as that temperature, which is lowest temperature registered out of a group of three thermometers when placed in engine room as follows:
 - .1 One thermometer located on each side of engine block, approximately two-thirds of length of block back from front (radiator) end of block, 900 mm out from block and at height equal to height of block.
 - .2 Locate third thermometer over end of exciter on unit centre line, approximately 150 mm above top of exciter.
 - .3 Take thermometer showing lowest temperature to give true ambient air temperature.
 - .4 Adjust temperature to maintain this thermometer at 40 degree C during heat test.
- .9 Voltage and frequency regulation tests: on completion of load tests take hot resistance reading of generator windings.
 - .1 Subject the unit to hot voltage and frequency regulation tests for full load to no load, 3/4 load to no load, load to no load, 1/4 load to no load and vice versa.
- .10 Panel performance and functions: check sequence of operation under service conditions.
 - .1 Make provision for supplying and connecting required levels of voltage for primary circuits.
 - .2 Test overcurrent relays by impressing current in secondary circuits.
- .11 Record test data on appendix forms, recording charts and manufacturers' test forms and be complete with diagrams and description of test results, deficiencies and corrective action.
 - .1 Ensure test data sheets signed by supplier and Departmental Representative.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions:
 - .1 Verify that substrate conditions, which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of liquid cooled diesel electric generating units.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install liquid cooled Diesel electric generating units to CAN3-Z299.3 and in accordance with manufacturer's written instructions.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 CLOSEOUT ACTIVITIES

- .1 Demonstration and Training:
 - .1 As directed by Departmental Representative and in accordance with Section 01 79 00 - Demonstration and Training carry out demonstrations of complete interruptible power unit for Project Acceptance Board.
 - .2 Provide familiarization training of operating and maintenance staff.
 - .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.
 - .4 Provide fuel required for performing site test and top-up after acceptance test completion.

3.5 MAINTENANCE - CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and CSA-B139.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.5-09, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, NMX-J-266-ANCE-2010).
 - .2 CSA C22.2 No.178.1-2007, Automatic Transfer Switches.
 - .3 CAN/CSA C60044-1-07, Instrument Transformers.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2-1996(R2009), Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, Part 8: Disconnect Devices for Use in Industrial Control Equipment.

1.3 ACTION AND INFORMATIONAL 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 transfer switches and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province Manitoba, Canada.
 - .1 Indicate on drawings:
 - .1 Make, model and type.
 - .2 Load classification:
 - .1 Restricted use: resistance and general loads, 0.8 pf.
 - .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.

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 transfer switches for incorporation into manual.
- .3 Detailed instructions to permit effective operation, maintenance and repair.
- .4 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.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .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 transfer switches from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 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.

2.2 MATERIALS

- .1 Instrument transformers: to CAN/CSA C60044-1.
- .2 Contactors: to NEMA ICS2.

2.3 CONTACTOR TYPE TRANSFER EQUIPMENT

- .1 Contact Type Transfer Equipment: to CSA C22.2 No.178.1.
- .2 Two 3 pole contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, with CSA enclosure solenoid operated,.
- .3 Rated: 600V, 60Hz, 600A. 357/600V 3Ø, 4 wire, solid neutral.
- .4 Main contacts: silver surfaced, protected by arc disruption means.
- .5 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.
- .6 Auxiliary contact: gold plated, to initiate emergency generator start-up on failure of normal power.
- .7 Fault withstand rating: 60 kA symmetrical for 3 cycles with maximum peak value of 60 kA.
- .8 Lever to operate switch manually when switch is isolated.
- .9 Neutral bar, solid rated: 600 A.
- .10 Overlapping neutral contacts on contactor type transfer equipment.

2.4 CONTROLS

- .1 Selector switch - 4 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 120 V 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: 3 phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum undervoltage and over voltage protection.
 - .2 Time delay: normal power to standby, adjustable solid state, 0 to 60 s.
 - .3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 0 to 60 s.
 - .4 Time delay on retransfer from standby to normal power, adjustable 0 to 60 s.

- .5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, 20 s intervals to 10 minutes.
 - .6 Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 5 s intervals to 180 s.
 - .7 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.
 - .8 Neutral disconnected position delay: allow time for motors to delay between live sources, adjustable, 0 to 5 s.
- .4 Solid state electronic in-phase monitor.

2.5 ACCESSORIES

- .1 Ensure pilot lights indicate power availability normal and standby, switch position, green for normal, red for standby, mounted 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 600 V.
 - .2 Ammeter: ac, scale 0 to 600 A.
 - .3 Frequency meter: scale 55 to 65 Hz.
- .4 Voltmeter selector switch: rotary, maintained contacts, panel mounting type, round notched handle, four position, labelled "OFF-Phase A-Phase B-Phase C".
- .5 Ammeter selector switch: rotary, maintained contacts, panel mounting type, designed to prevent opening of current circuits, round notched handle, four position labelled "OFF - Phase A - Phase B - Phase C".
- .6 Manual bypass and isolator: to normal supply to emergency supply to both supplies.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Control panel:
 - .1 For selector switch and manual switch: size 4 5 nameplates.
 - .2 For meters, indicating lights, minor controls: use size 2 3 nameplates.

2.7 SOURCE QUALITY CONTROL

- .1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Departmental Representative.
- .2 Notify Departmental Representative 5 day's minimum in advance of date of factory test.
- .3 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.
 - .4 In-phase monitor operation.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transfer switches 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 Locate, install and connect transfer equipment.
- .2 Check relays solid state monitors and adjust as required to ensure correct operation.
- .3 Install and connect battery remote alarms.

3.3 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 minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.

- .7 Repeat, at 1 hour intervals, 4 times, complete test with selector switch in each position, for each test.

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.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - .1 IEEE 837-2002, Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA International
 - .1 CAN/CSA-B72-M87(R2008), Installation Code for Lightning Protection Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
 - .2 Indicate materials and methods of attachment of conductors to air terminals sky wire and electrodes.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect lighting protection from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Lightning Rods: copper solid rod.
- .2 Conductor: copper stranded #2/0 gauge.
- .3 Fastenings and attachment straps: copper.
- .4 Ground electrodes: 3m x 19mm diameter copper coated steel.
- .5 Use copper conductors, terminals, connectors and fastenings for buildings sheathed in other than aluminum.
- .6 Connections: copper connections formed by thermit process.

2.2 DESCRIPTION

- .1 System to consist of metallic air terminals, lightning conductors connecting air terminals to ground and interconnected ground electrodes, and/or ground cables.

2.3 REGULATORY REQUIREMENTS

- .1 System subject to: approval by authority having jurisdiction.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for lightning protection 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 lightning protection to CAN/CSA-B72.
- .2 Bond discharge conductors to service mast or other non-current-carrying electrical parts.
- .3 Submit certificate of installation to Departmental Representative.

3.3 INSPECTION

- .1 Obtain inspection certificate from Departmental Representative for discharge conductor passing through any fire supporting membrane.

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.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
- .3 ASTM International Inc.
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005-07, Radio Frequency Lighting Devices.
- .6 Underwriters' Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL 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 Consultant.
 - .3 Photometric data to include: 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, 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.

Part 2 Products

2.1 FINISHES

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

2.2 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire schedule.

2.3 LUMINAIRES

- .1 As indicated in luminaire schedule.

Part 3 Execution

3.1 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 conduit for luminaires as indicated.

3.3 LUMINAIRE SUPPORTS

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

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.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.141-10, Emergency Lighting Equipment.

1.2 ACTION AND INFORMATIONAL 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.

1.3 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.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors 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.

1.5 WARRANTY

- .1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 120 months.

Part 2 Products

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120V, AC.
- .3 Output voltage: 24V DC.
- .4 Operating time: 60 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 remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 20W, minimum.
- .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: Beige
- .13 Auxiliary equipment:
 - .1 Ammeter.
 - .2 Voltmeter.
 - .3 Test switch.
 - .4 Time delay relay.
 - .5 Battery disconnect device.
 - .6 AC input and DC output terminal blocks inside cabinet.
 - .7 Shelf Bracket.
 - .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: RW90 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 or Contracts 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.

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.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-02, Unit Equipment for Emergency Lighting.
 - .2 CSA C860-01(December 2002), Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 101-2006, Life Safety Code.

1.2 ACTION AND INFORMATIONAL 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.

Part 2 Products

2.1 STANDARD UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: cold rolled steel minimum 1.0 mm thick, satin aluminum enamel finish extruded aluminum housing, brush aluminum finish.
- .3 Face back plates: extruded aluminum.
- .4 Lamps: multiple – LED – 24V, 120V, 10,000 hours.
- .5 Letters: 150mm high x 19 mm, with 13 mm thick stroke red on die-cast aluminum face, reading EXIT SORTIE.
- .6 Downlight: white glass translucent acrylic in bottom of unit.
- .7 Third lamp socket for emergency lamp lighting circuit.
 - .1 Third lamp:10 W, 120V ac.
- .8 Face plate to remain captive for relamping.

2.2 SELF-POWERED UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: cold rolled steel minimum 1.0mm thick, satin aluminum enamel finish cast anodized extruded aluminum housing, brush aluminum finish.
- .3 Face and back plates: extruded aluminum.
- .4 Lamps: multiple LED-12W 120V.
- .5 Letters: 150mm high x 19mm wide, with 13 mm thick stroke, red on die-cast aluminum face, reading EXIT SORTIE.

- .6 Downlight: white glass translucent acrylic in bottom of unit.
- .7 Third lamp socket for emergency lamp lighting circuit.
 - .1 Third lamp: 10W, 120V ac.
- .8 Face plate to remain captive for relamping.
- .9 Supply voltage: 120V, ac.
- .10 Output voltage: 24V dc.
- .11 Operating time: 60 minimum.
- .12 Recharge time: 12 hours
- .13 Battery: sealed, maintenance free.
- .14 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.
- .15 Solid state transfer circuit.
- .16 Signal lights: solid state, for 'AC Power ON' condition.
- .17 Lamp heads: integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment.
 - .1 Lamp type: LED, 20W, minimum 100 lumen output.
- .18 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.
 - .1 Removable or hinged front panel for easy access to batteries.
- .19 Cabinet: finish: Beige.
- .20 Auxiliary equipment:
 - .1 Ammeter.
 - .2 Voltmeter.
 - .3 Lamp disconnect switch.
 - .4 Test switch.
 - .5 AC/DC output terminal blocks inside cabinet.
 - .6 RFI suppressor.
 - .7 Cord and single twist-lock plug connection for AC power supply.

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.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA Group
 - .1 CSA C22.2 No.206-13, Lighting Poles.

1.2 ACTION AND INFORMATIONAL 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 roadway lighting 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 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 roadway lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 STEEL POLES

- .1 Steel poles: to CSA C22.2 No.206 designed for underground wiring and:
 - .1 Mounting on concrete anchor base.
 - .2 Style: 15.2 meter high, tapered round.
 - .3 Minimum wall thickness of 6.07mm. Increase as required for loading.
 - .4 Finish: Galvanized.
 - .5 Grounding lug.

2.2 LUMINAIRE MOUNTING BRACKETS

- .1 Mounting brackets steel for specified luminaires:
 - .1 Multiple, single brackets as indicated for a minimum of five (5) luminaires per bracket.
 - .2 Arm extension length: To suit luminaire count.
 - .3 Type: Tubular cross arm.

2.3 LUMINAIRES

- .1 Luminaire with cast aluminum weatherproof housing and:
 - .1 Luminaire type: LED, wattage: 1000W. Initial (1200 max)
 - .2 Driver: 347V, in accordance with Section 26 50 00 - Lighting.
 - .3 Lumen output: 115,000 maintained.
 - .4 Light Distribution:
 - .1 As required by provider to suit installation.
 - .5 Design criteria shall be inclusive to this 10 year warranty period.
 - .6 CRI 80+ at ground level.
 - .7 Colour tuning: (4000k-6500k)
 - .8 Contractor shall provide all requirements to adjust and aim luminaires for maximum coverage and minimum high/low ratios.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roadway 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 poles true and plumb, complete with brackets in accordance with manufacturer's instructions.
- .2 Install luminaires on pole.
- .3 Check luminaire orientation, level and tilt.
- .4 Connect luminaire to lighting circuit.
- .5 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .6 Contractor shall provide wind load calculations for review by structural consultant prior to ordering poles and luminaires.
- .7 Luminaire count on Drawings is representational only. Each provider will need different count of luminaires to meet requirements. Contractor shall be responsible to meet requirements and correct all deficiencies. Contractor shall provide complete photo metric layout of installation for consultant review.

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.

END OF SECTION