

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 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 CSA Group
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

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 and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit for review single line electrical diagrams under plexiglass and locate as indicated.
 - .1 Electrical distribution system in main electrical room.
- .4 Submit for review fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.
- .5 Shop drawings:
 - .1 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.
 - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

- .3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .4 Submit required copies of 600 x 600 mm minimum size drawings and product data to authority having jurisdiction and inspection authorities.
- .5 If changes are required, notify Departmental Representative of these changes before they are made.
- .6 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.
- .7 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.
- .8 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .9 Operation and Maintenance Data: submit operation and maintenance data 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 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
 - .4 Post instructions where directed.
 - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

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, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 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.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification labels for control items in English.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material or equipment are not available, obtain special approval from inspection authorities 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 120V control wiring be electrical Contractor. Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Wiring and connections below 50 V which are related to control systems specified in mechanical sections. Executed by Controls Contractor.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction or inspection authorities.

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

- .2 Sizes as follows:

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

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
 - .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
 - .4 Switches and receptacles to be identified with Panel and circuit designation.
 - .5 Panels and equipment identification to indicate voltage and where they are fed from in nameplate.
 - .6 Allow for minimum of twenty-five (25) letters per label.
 - .7 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
 - .8 Confirm with Consultant or Departmental Representative before proceeding: Identification of equipment with Size 3 labels engraved "ASSET INVENTORY NO. "
 - .9 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
 - .10 Terminal cabinets and pull boxes: indicate system and voltage.
 - .11 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

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

2.8 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 and exit wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 2 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 indoor 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 pipe PVC, 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 and as indicated on drawings following maintaining the building heritage's nature.
- .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 Where required, locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and lift machine rooms on latch side of floor.

3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 Due to heritage requirements exact location of all devices to be verified with Departmental Representative and Parks Canada before roughing-in with a minimum one week in advance.
- .3 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .4 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: at wall casing level on existing plaster walls or 300 mm in new walls or electrical rooms.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Fire Alarm pull stations: 1050 to 1150 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 operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm and communications.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - 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 MOCK-UP

- .1 Provide complete lighting mock-up in Big House room R15.
- .2 Prepare mock up for Departmental Representative and Consultant's review with reasonable promptness and in an orderly sequence, so as not to cause any delay in work.

- .3 Mock-up may remain as part of work if accepted by Departmental Representative and Consultant.

3.10 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.

3.11 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 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

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 NMJ-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 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 wire and box connectors from nicks, scratches, and blemishes.
 - .3 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 copper 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 NEMA to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable aluminum sheathed 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 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.

- .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 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 PRODUCT DATA

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

1.3 DELIVERY, STORAGE AND HANDLING

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

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.

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 as indicated, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 Fastenings:
 - .1 One hole aluminum straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1500 mm centers.
 - .3 Threaded rods: galvanized, 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight approved for TECK cable.

2.3 ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90 – non lead sheath over cable assembly and under armour.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Type: PVC flame retardant jacket over thermoplastic armour and compliant to applicable Building Code classification for this project.
- .5 Connectors: anti short connectors.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

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

3.2 GENERAL CABLE INSTALLATION

- .1 Install cable in trenches in accordance with Section 33 71 73.02 - Underground Electrical Service.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors -
- .3 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .4 Conductor length for parallel feeders to be identical.
- .5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .6 Wiring in new 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.
- .7 Wiring in existing plaster walls: not allowed
- .8 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:
 - BIG HOUSE
 - .1 New walls: In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 Plaster walls: no wiring permitted
 - FURLOFT
 - .1 Re-use existing routes with new conduit systems for receptacles in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 Use existing shaft at center of the building adjacent to staircase.

- .3 Plaster walls: no wiring permitted

MENS HOUSE

- .1 Use existing shaft as indicated on drawings with new conduit systems for receptacles in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Plaster walls: no wiring permitted

3.4 INSTALLATION OF TECK90 CABLE

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

3.5 INSTALLATION OF ARMOURED CABLES

- .1 Use cables not longer than 1.5m for suspended lighting in mechanical or electrical rooms or to wire recessed luminaires in dropped ceilings. Group cables wherever possible on channels.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

- .1 CSA Group
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
 - .3 CSA C22.2 No.65-[13], Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

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 connectors and terminations 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 connectors and terminations 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 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 connectors and terminations from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper long barrel compression connectors to CSA C22.2 No.65 as required sized for conductors.

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 connectors and terminations 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 Bond and ground as required to CSA C22.2No.41.

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 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

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 grounding equipment 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 grounding equipment for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive ground rod (min one rod) in each electrical room of each building.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as required.
- .3 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m long.

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

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment 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 GENERAL

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

- .10 Connect building structural steel and metal siding to ground by welding copper to steel.
- .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .12 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end and load end.
- .13 Ground secondary service pedestals.

3.3 MAINTENANCE HOLES

- .1 Install conveniently located grounding stud, electrode, size as indicated stranded copper conductor in each maintenance hole.
- .2 Install ground rod in each maintenance hole so that top projects through bottom of maintenance hole. Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code 23rd Edition minimum requirements.

3.4 ELECTRODES

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2 Install water meter shunt.
- .3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.
- .4 Install rod electrodes and make grounding connections as indicated.
- .5 Bond separate, multiple electrodes together.
- .6 Use size 3/0 AWG copper conductors for connections to electrodes.
- .7 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.5 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of primary 600 V system, secondary 120/208 V system.

3.6 EQUIPMENT GROUNDING

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

3.7 GROUNDING BUS

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

3.8 COMMUNICATION SYSTEMS

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

3.9 FIELD QUALITY CONTROL

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

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 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

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 hangers and supports 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 hangers and supports from [nicks, scratches, and blemishes.
 - .3 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 galvanized channels surface mounted, suspended in walls and ceilings.

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 Maintain "integrity" of heritage and historic construction components of the building. Drilling on walls, ceilings or flooring is not accepted unless authorized by Departmental Representative and Parks Canada Agency. Obtain confirmation in writing if unsure.
- .2 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors with previous authorization.
- .3 Secure equipment to poured concrete with expandable inserts. Conduits are not acceptable to run horizontally on walls.
- .4 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .5 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.
- .6 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .7 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .8 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.
- .9 For surface mounting of two or more conduits use channels as per CEC spacing.
- .10 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .11 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .12 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .13 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.
- .14 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.
- .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 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

1.3 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 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure with lock and 2 keys.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on turned edge covers.
- .4

2.2 CABINETS

- .1 Construction: welded sheet steel hinged door, handle, latch, lock 2 keys and catch
- .2 Type E Empty: surface return flange mounting.
- .3 Type T Terminal: flush overlapping sides mounting containing sheet steel 19 mm G1S fir plywood backboard.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name voltage and phase or as indicated.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals 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 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 tile walls.

2.3 CONDUIT BOXES

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

2.4 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.5 FITTINGS - GENERAL

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

Part 3 Execution

3.1 INSTALLATION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section [_____].

1.2 REFERENCES

- .1 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-NC-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations 2009.
 - .3 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.
 - .4 LEED Canada-EB: O M-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Existing Buildings: Operations and Maintenance 2009.
- .2 CSA International
 - .1 CSA C22.2 No.40-[M1989(R2009)], Cutout, Junction and Pull Boxes.

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 [raceway and boxes] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
 - .1 LEED Canada submittals: in accordance with [Section 01 35 21 - LEED Requirements].
 - .2 Construction Waste Management:
 - .1 Submit project [Waste Management Plan] [Waste Reduction Workplan] highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that [50] [75]% of construction wastes were recycled or salvaged.

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 [raceway and boxes] 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] [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 [raceway and boxes] from [nicks, scratches, and blemishes].
 - .3 Replace defective or damaged materials with new.
- .4 Develop [Construction Waste Management Plan] [Waste Reduction Workplan] related to Work of this Section and in accordance with Section [01 35 21 - LEED Requirements].
- .5 Packaging Waste Management: remove for reuse [and return] [by manufacturer] of [pallets,] [crates,] [padding,] [packaging materials] as specified in [Construction Waste Management Plan] [Waste Reduction Workplan] in accordance with Section [01 74 21 - Construction/Demolition Waste Management and Disposal] [Section 01 35 21 - LEED Requirements].

Part 2 Products

2.1 SPLICE BOXES

- .1 Splice boxes cast iron enclosures 6 mm thick painted with chromate primer and gray enamel to provide mechanical protection and moisture seal for direct buried cable splices rated [0.48] [0.6] [3] [5] [7.5] kV and consisting of:
 - .1 Two halves, split along cable axis, finely ground matching surfaces, fastened with [silicon bronze] [galvanized steel] bolts, top half with large filling holes with gasketed plugs for medium hard asphalt base compound, bottom half with screws on inside for bonding [lead sheath] [armour], and box end openings sealed by:
 - .1 Wrapping cables with anhydrous tape and clamping to make snug fit, for [2] [3] [4] way splices.
 - .2 Fitting boxes with cable entrance fittings suitable for [lead] [neoprene] [steel tape armour] [interlocking armour] sheaths, for [2] [3] [4] way splices.
- .2 Submarine splice boxes to provide mechanical protection and waterproof seal for submarine cables as follows:
 - .1 Cast iron split boxes with cast iron cones and split armour clamps painted with chromate primer and gray enamel with four bronze rods fastened rigidly to splice box and attached to armour clamps to relieve joint of longitudinal stress, designed to be filled with medium hard asphalt base compound, and rated [3] [5] [7.5] kV.
 - .2 Galvanized steel pipe with filling holes for medium hard asphalt base compound, gasketed plugs, with ends right hand and left hand threaded, cast steel end caps with wire armour clamps, to relieve conductors and splice from mechanical stresses.

2.2 JUNCTION BOXES SUBWAY LEVEL

- .1 Cast iron octagonal box with joints ground smooth and sealed with gasket, painted with chromate primer and gray enamel fitted with contacts mounted on porcelain supports to which conductors are fastened by soldered-on lugs, air filled, suitable for 3 phase, 5 kV non-shielded cable up to 500 MCM, [2] [3] ways, for direct burial.
- .2 Welded steel rectangular boxes, gasketed steel plate lid, fastened with silicon-bronze bolts, copper buses mounted on insulating supports, [wiring sleeve] [stuffing box] entrances, cable conductor lugs detachable from bus contacts at no voltage, rated 500 MCM maximum at 3 pole, 5 kV, [2] [3] [4] [5] [6] way, designed for wall mounting in [maintenance hole] [tunnel].
- .3 Welded steel rectangular boxes, painted with chromate primer and gray enamel, steel plate lids, galvanized forged steel C clamps, silicon-bronze screws, oil resistant gaskets, lined and phases partitioned with bakelite, copper strap buses plastic insulation enclosed mounted on porcelain supports, disconnecting links, insulated switch stick operated at no voltage, interchangeable unit cable heads compound filled, equipped with air valve, designed to operate at 14 kPa air pressure, rated 3 phase, [5] [7.5] kV, [250] [500] A with number of ways and sets of disconnecting links, for wall mounting in [maintenance holes] [tunnels].

2.3 JUNCTION BOXES DISTRIBUTION LEVEL

- .1 Welded steel rectangular boxes [6] mm thick minimum painted with chromate primer and gray enamel with removable plate on front side, designed for through run of main cable and porcelain enclosed disconnecting branches of [2] [3] single conductor cables, using pothead plug and socket disconnectors enclosed in porcelain tubes and caps, [standard] [deep overlapping for submersion] designed for no voltage disconnecting, and for wall mounting in [maintenance holes] [tunnels], branch cables rated [100] [250] A, 5 kV, filled with medium hard asphalt base compound.

2.4 JUNCTION BOXES POWER LEVEL

- .1 Cast iron octagonal box painted with chromate primer and gray enamel with joints ground smooth and fitted with gasket, contacts mounted on porcelain supports to which conductors are fastened by soldered-on lugs, medium hard asphalt compound filled, suitable for 3 phase, 15 kV cable, 250 MCM maximum cable size, with [wiping sleeve] [stuffing box] entrance.
- .2 Welded steel rectangular boxes, oil resistant gasketed steel plate lids fastened with silicon-bronze bolts, shot blasted and painted with chromate primer and gray enamel, cable heads medium hard asphalt compound filled cap nut sealed potheads with [wiping sleeve] [stuffing box] entrances, [oil filled] [air filled], disconnecting links insulated switch stick operated at no voltage rated [250] [500] A at [7500] [15,000] V, [3] [4] way for wall mounting in [maintenance holes] [tunnels].

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 raceway and boxes installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of [Departmental Representative] [DCC Representative] [Consultant].

- .2 Inform [Departmental Representative] [DCC Representative] [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 [Departmental Representative] [DCC Representative] [Consultant]].

3.2 INSTALLATION

- .1 Install splice boxes at cable joint, on floor of trench. Tighten armour clamps and fill with compound.
 - .1 Ground splice boxes as required.
- .2 Install submarine splice boxes at cable joints, tighten clamps and fill with compound before lowering cable to [river] [lake] [sea] bed.
- .3 Install junction boxes on trench floor around cable splice to [CSA C22.2 No.40]. Connect cable terminals to box contacts.
 - .1 Ground junction boxes as required.
 - .2 Fasten lid securely and check for air leaks before trench is backfilled.
- .4 Install subway level steel boxes on wall of [maintenance holes] [tunnels]. Connect cables to bus, install links, fasten lid and [test for air leaks] [fill with compound].
 - .1 Ground steel boxes as required.
- .5 Install distribution level steel boxes on walls of [maintenance holes] [tunnels]. Splice main cable in box and connect branch feeder. Fasten cover and fill with compound.
 - .1 Ground steel boxes as required.
- .6 Install power level boxes as follows:
 - .1 Cast iron type: on trench floor, connect cable terminals to box contacts, fasten lid and fill with compound before trench is backfilled.
 - .2 Steel type: mount on wall of [maintenance holes] [tunnel]; connect cables to box terminals; install disconnect links, fasten lid securely [fill with oil] [check for air leaks].
 - .3 Ground power level boxes as required.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section [01 74 11 - Cleaning].
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section [01 74 11 - Cleaning].
- .3 Waste Management: separate waste materials for [reuse] [recycling] in accordance with Section [01 74 21 - Construction/Demolition Waste Management and Disposal] [01 35 21 - LEED Requirements].
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

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.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

Part 2 Products

2.1 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 expanded ends.
- .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.
- .6 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3.

2.2 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.

2.3 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.

2.4 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.

2.5 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 Maintain "integrity" of heritage and historic construction components of the building. Drilling on walls, ceilings or flooring is not accepted unless authorized by Departmental Representative and Parks Canada Agency. Obtain confirmation in writing if unsure.
- .2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Conduits are not allowed to run horizontally on walls.
- .3 Conceal conduits except in mechanical and electrical service rooms or in unfinished areas.
- .4 Use rigid galvanized steel threaded conduit where required.
- .5 Use epoxy coated conduit underground in corrosive areas.

- .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 and corrosive areas.
- .8 Use flexible metal conduit for connection to motors in dry areas work in movable metal partitions.
- .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- 25 mm spare conduits up to ceiling space and 2- 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 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.
- .7 Conduits to be painted to match surface color where it is installed.

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.

3.8 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

1.1 GENERAL REQUIREMENTS

- .1 The completed Overcurrent and Coordination Study shall be prepared and include all time current characteristic curves plotted on log paper.
- .2 Provide Arc Flash Study
- .3 The Overcurrent and Coordination Study and Arc Flash Hazard Study shall reflect the complete distribution systems including the equipment product data of 600V and 120/208V distributions and all associated buildings protection devices.
- .4 The Overcurrent and Coordination Study and Arc Flash Hazard Study shall include a professional electrical engineer's stamp of the Province of Manitoba and statement clearly confirming the selective and fully coordinated system permits maximum service continuity. Include all costs in contract.
- .5 Labels as per NFPA70E to be affixed to all distribution equipment indicating:
 - .1 Nominal System Voltage
 - .2 Arc Flash Boundary
 - .3 At least one of the following:
 - .1 Available Incident Energy and the corresponding Working Distance, or the Arc Flash PPE Category for the equipment, but not both
 - .2 Minimum Arc Rating of clothing
 - .3 Site-specific level of PPE
- .6 Submit a complete Short Circuit and Time-Current Coordination Study for new the breakers and fuses provided under this contract.
 - .1 Include all upstream overcurrent protection up to and including the main switch in the normal main distribution.
 - .2 Curves shall be plotted on a standard log-log scale as time versus current values on a common base. It shall be the responsibility of the Division 26 contractor to provide time-current curves of all breakers, fuses, etc.
 - .3 The study shall:
 - .1 Select settings and characteristics for the protective devices in order to achieve maximum selectivity between devices during fault conditions (ie. the device nearest the fault will operate first, thus minimizing the interruption) and to provide proper protection for all distribution equipment, transformers, cable.
 - .2 Determine the fault currents at critical points in the power system under the worst case conditions in order to ensure the adequacy of the electrical equipment and protective devices. Motor contribution is to be taken into account.
 - .3 Include all breakers in CDP type panelboards. Breaker settings shall be listed in the study for all breakers with adjustable trips.
 - .4 In addition to the curves for the protective devices, each drawing shall show and include proper protection and coordination for:

- .1 Transformer inrush points.
- .2 Transformer full load currents.
- .3 Transformer damage curves (single phase and three phase).
- .4 Cable damage curves.
- .5 The largest motor or motors likely to present coordination problems.
- .5 All required breaker settings shall be listed in table form including breaker details such as breaker type, trip rating, etc. All breakers with adjustable trips shall be included in this list.
- .6 Maximum available short circuit currents shall be listed for each bus. This listing shall also include the interrupting rating of the protective devices actually supplied in the contract.
- .7 In all cases use actual values for transformer impedance, cable types, cable sizes, cable lengths, available utility fault current, etc.
- .8 Identification names and numbers for breakers and distribution in the study shall match the identification shown on the contract documents.
- .9 The short circuit and coordination study shall be done by a Professional Engineer licensed in the Province of Manitoba and the study shall be signed and sealed by the Professional Engineer.
- .10 Ground fault curves shall be plotted on the same drawings as overcurrent curves to ensure proper coordination.
- .11 As a minimum, the study shall be bound in a 3-ring loose leaf binder and shall include:
 - .1 A title sheet listing the study name, project name, project number, date, engineering company that prepared the study (including address and phone number), the engineers seal and signature, etc.
 - .2 Table of Contents.
 - .3 Purpose of the study.
 - .4 The criteria for determining proper selective coordination, protection, adequacy, etc. (eg. describe when coordination is achieved, minimum/maximum tripping times and current values, separation between curves, safety margins, damage curves, etc.).
 - .5 Summary stating that proper selective coordination, proper protection, adequacy of the equipment for the maximum available short circuit currents, etc. was achieved and listing any areas of compromise, potential problems, marginal adequacies, etc.
 - .6 Drawings of the breaker curves showing proper selective coordination, protection, adequacies, etc. On each drawing, include a single line diagram of the distribution for the curves shown on the drawing, breaker settings, etc.
 - .7 Maximum available short circuit currents at each bus.
- .12 The study shall be started immediately on award of contract and shall be submitted as a shop drawing for review in advance of distribution shop drawings.
- .13 All breakers shall be set per the curves in the coordination study.
- .14 The product specific Short Circuit and Time-Current Coordination Study (revised to as-built conditions) shall be included in the Operating and Maintenance Manuals.
- .15 A summation chart showing all ratings and settings with reference to the appropriate curves.

- .16 Recommendations and comments on the effectiveness of the coordination study.
 - .17 A system single line diagram indicating circuit identification, device numbers and equipment ratings.
 - .18 Drawings generated by a computer aided drafting system. Drawings to be provided on departmental representative approved AutoCAD system and version.
 - .7 Contractor Responsibilities:
 - .1 In the event that the studies indicate necessary changes to provide proper coordination, the distribution equipment Supplier and Contractor shall include for the changes in circuit breaker sizes, trip settings, wire sizes, etc., to enable coordination with downstream devices. Include all costs in the contract price.
 - .2 The studies shall be completed and reviewed by the General Contractor and the electrical contractor prior to equipment being ordered, include revisions and then submit to the departmental representative for review along with the shop drawings.
 - .8 Visit the site and commission the equipment settings with test instruments. Submit verification test results to the departmental representative.
- 1.2 Arc Flash Hazard Analysis
 - .1 Scope
 - .1 The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer under this contract.
 - .2 Submittals For Construction
 - .1 Arc flash labels shall be provided in hard copy only and affixed to the relevant equipment.
 - .3 Qualifications
 - .1 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.
 - .4 Studies
 - .1 The contractor shall furnish an Arc Flash Hazard Analysis Study report and schematics (including calculations) per latest edition of CSA Z462, NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.
 - .5 Arc Flash Hazard Analysis
 - .1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in latest CSA Z462, NFPA70E, Annex D.
 - .2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (panelboards, busway and splitters) where work could be performed on energized parts.
 - .3 The Arc-Flash Hazard Analysis shall include all significant locations in 208volt and 600 volt systems.
 - .4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

- .5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- .6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment locations. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculations will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- .7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculation on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - .1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 - .2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- .8 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- .9 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculations.
- .10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- .11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
- .12 Incident energy and flash protection boundary calculations
 - .1 Arcing fault magnitude
 - .2 Protective device clearing time
 - .3 Duration of arc
 - .4 Arc flash boundary
 - .5 Working distance

- .6 Incident energy
- .7 Hazard Risk Category
- .8 Recommendations for arc flash energy reduction
- .6 Field Adjustment
 - .1 Arc Flash Warning Labels
 - .1 The contractor of the Arc Flash Hazard Analysis shall provide a 3.5in. x 3.5in. thermal transfer type label of high adhesion polyester for each work location analyzed.
 - .2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to departmental representative and after any system changes, upgrades or modifications have been incorporated in the system.
 - .3 The label shall include the following information, at a minimum:
 - .1 Location designation
 - .2 Nominal voltage
 - .3 Flash protection boundary
 - .4 Hazard risk category
 - .5 Incident energy
 - .6 Working distance
 - .7 Engineering report number, revision number and issue date
 - .4 Labels shall be machine printed, with no field markings.
 - .5 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - .1 For each 600 volt panelboard, one arc flash label shall be provided.
 - .2 For each motor control centre, one arc flash label shall be provided.
 - .3 For each low voltage switchboard, one arc flash label shall be provided.
 - .4 For each switchgear, one flash label shall be provided.
 - .5 For medium voltage switches one arc flash label shall be provided.
 - .6 Labels shall be field installed by Electrical Contractor.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submittals shall be in accordance with Section 26 05 00 Common Work Results - Electrical.
- .2 Submit Coordination Study at the same time as the Switchboard & Distribution Equipment shop drawings are submitted.
- .3 Submit Arc Flash Hazard Study shop drawings at the same time as the Switchboard & Distribution Equipment shop drawings are submitted.
- .4 Contractor Responsibilities:

- .1 In the event that the studies indicate necessary changes to provide proper coordination, the distribution equipment Supplier and Contractor shall include for the changes in circuit breaker sizes, trip settings, wire sizes, etc., to enable coordination with downstream devices. Include all costs in the contract price.
- .2 The studies shall be completed and reviewed by the General Contractor and the Commissioning Officer prior to equipment being ordered, include revisions and then submit to the Consultant for review along with the shop drawings.
- .5 Visit the site and commission the equipment settings with test instruments. Submit verification test results to the Consultant.

PART 2 Products

- .1 Not used.

PART 3 Execution

- .1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.

1.3 SUMMARY

- .1 The lighting control system specified in this section shall provide time-based and manual lighting control.
- .2 The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)
- .3 All system devices shall be networked via Radio Frequency (RF).
- .4 The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.
- .5 The system architecture shall facilitate remote operation via a computer connection.
- .6 The system shall not require any centrally hardwired switching equipment.
- .7 The system shall be capable of wireless architectures.

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 network lighting controls and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature)
 - .3 Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)
 - .4 Other Diagrams – as needed for special operation or interaction with other system(s)
 - .5 Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
 - .6 Hardware and Software Operation Manuals
 - .7 Other operational descriptions as needed
- .3 Shop Drawings:
 - .1 Indicate on drawings:

- .1 Complete assembly.
- .2 Contact surfaces.
- .3 Construction features.
- .4 Wiring diagrams.

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 network lighting controls for incorporation into manual.
- .3 Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature)
- .4 Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)
- .5 Other Diagrams – as needed for special operation or interaction with other system(s)
- .6 Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
- .7 Hardware and Software Operation Manuals
- .8 Other operational descriptions as needed

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 network lighting controls from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.7 QUALITY ASSURANCE

- .1 Include population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
- .2 All components and the manufacturing facility where product was manufactured must be ROHS compliant.
- .3 In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
- .4 All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.8 COORDINATION

- .1 Coordinate lighting control components to form an integrated interconnection of compatible components.
- .2 The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.9 WARRANTY

- .1 All devices in lighting control system shall have a 5 year warranty.

Part 2 Products

2.1 GENERAL

- .1 Provide hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
- .2 BACnet Interface:
 - .1 Provide ability to communicate by means of BACnet IP or BACnet Ethernet communication to centralized lighting system from user-supplied 10BaseT Ethernet network.
 - .2 Provide PIC list definition and object model to other system manufacturers.

2.2 SYSTEM REQUIREMENTS

- .1 Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) as suitable for the purpose indicated.
- .2 Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, programming, etc. as necessary for a complete operating system that provides the control intent indicated.
- .3 Typical dimming equipment is rated for 40 degrees C (104 degrees F). This is the maximum ambient temperature that can exist while the dimming equipment is operating at full load conditions. Include the following paragraph to ensure that the operating equipment is designed to operate at worst case environmental conditions without affecting product life.
- .4 Design lighting control equipment for 10 year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90 percent non-condensing relative humidity.
- .5 Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.
- .6 Power dropouts occur frequently. The momentary interruption of power should not cause extended periods without lighting or require some manual intervention to reset the lighting system. Some manufacturers may define power failure memory as a feature that handles momentary power outages on the order of 20 seconds. This does not account for power outages that occur for a longer period of time.
- .7 Power Failure Recovery: When power is interrupted and subsequently restored, lights to automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
- .8 Wireless Devices:

- .1 Wireless device family includes area or fixture level load controls for dimming or switching, and load controls that can be mounted in a wallbox, on a junction box, or at the fixture.
 - .2 Wireless devices including load controls, and wireless remotes or wall stations, can be set up using simple button press programming without needing any other equipment (e.g. central hub, processor, computer, or other smart device).
 - .3 Wireless hub adds the ability to set up the system using any smart device with a web browser (e.g. smartphone, tablet, PC, or laptop).
 - .4 System does not require a factory technician to set up or program the system.
 - .5 Capable of diagnosing system communications.
 - .6 Capable of having addresses automatically assigned to them.
 - .7 Receives signals from other wireless devices and provides feedback to user.
 - .8 Capable of determining which devices have been addressed.
 - .9 RF Range: 60 feet (18 m) line-of-sight or 30 feet (9 m) through typical construction materials between RF transmitting devices and compatible RF receiving devices.
 - .10 The FCC sets limits on EMI/RFI for both non-consumer (commercial and industrial) and consumer (residential) applications. The class B, consumer limits are more stringent than the class A, non-consumer limits.
 - .11 Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 15, for Class B application.
- .9 Wireless Network:
- .1 RF Frequency: 434 MHz; operate in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
 - .1 Fixed network architecture ensures all associated lights and load controls respond in a simultaneous and coordinated fashion from a button press, or command from the wireless hub.
 - .2 Distributed Architecture: Local room devices communicate directly with each other. If the wireless hub is removed or damaged, local control, sensing, and operation continues to function without interruption.
 - .3 Local room devices communicate directly with each other (and not through a central hub or processor) to ensure:
 - .1 Reliability of system performance.
 - .2 Fast response time to events in the space (e.g. button presses).
 - .3 Independent operation in the event of the wireless hub being removed or damaged.
- .10 Device Finishes:
- .1 Wall Controls: White
 - .2 Standard Colors: Comply with NEMA WD1 where applicable.
 - .3 Color Variation in Same Product Family: Maximum delta E of 1, CIE L*a*b color units.
 - .1 Daylight or fluorescent lighting generate ultraviolet light which can cause parts that do not meet ASTM D4674 to discolor/yellow over time.
 - .2 Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

- .1 Load Control Modules
 - .1 Provide wireless load control modules as indicated or as required to control the loads as indicated.
 - .2 Junction Box-Mounted Modules:
 - .1 Plenum rated.
 - .2 Dimming Modules:
 - .1 Product(s):
 - .1 8 A dimming module with magnetic low voltage control
 - .2 Communicates via radio frequency with up to ten wireless control stations.
 - .3 Selectable minimum light level.
 - .4 Configurable high- and low-end trim.
 - .5 Relay: LED magnetic low voltage.
- .2 Relay Modules:
 - .1 Product(s):
 - .1 16 A relay module, without contact closure output.
 - .2 16 A relay module, with contact closure output.
 - .3 5 A relay module, without contact closure output.
 - .4 5 A relay module, with contact closure output
 - .2 Communicates via radio frequency with up to ten compatible wireless control stations.
 - .3 Relay:
 - .1 Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
 - .2 Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
 - .3 Fully rated output continuous duty for inductive, capacitive, and resistive loads.
 - .4 Contact Closure Output:
 - .1 Single contact closure output with normally open and normally closed dry maintained contacts suitable for connection to third party equipment (e.g. building management system, HVAC system, etc.).
 - .2 Contact Ratings: Resistive load; 1 A at 0-24 VDC, 0.5 A at 0-24 VAC.
 - .3 Controlled by associated occupancy/vacancy sensors and wall controls.
 - .5 Contact Closure Output Modules:
 - .1 Communicates via radio frequency with up to ten compatible wireless control stations.
 - .2 Contact Closure Output:
 - .1 Single contact closure output with normally open and normally closed dry maintained contacts suitable for connection to third party equipment (e.g. building management system, HVAC system, etc.).
 - .2 Contact Ratings: Resistive load; 1 A at 0-24 VDC, 0.5 A at 0-24 VAC.

- .3 Operation affected by associated occupancy/vacancy sensors and wall controls.
- .3 Fixture Control Modules/Sensors:
 - .1 Fixture Control Modules:
 - .1 Communicates via radio frequency with up to ten compatible occupancy/vacancy sensors, ten wireless control stations, and one daylight sensor.
 - .2 Communicates via wired input with one combination occupancy/daylight or vacancy/daylight fixture sensor.
 - .3 Coordination between Wired and Wireless Sensors:
 - .1 Occupancy/Vacancy Sensing: Wired and wireless sensors work in conjunction (occupancy detected by either sensor turns lights on and vacancy detected by both sensors turns lights off).
 - .2 Daylight Sensing: Wireless sensor takes precedence over wired sensor.
 - .4 Selectable minimum light level.
 - .5 Configurable high- and low-end trim.
 - .6 Plenum rated.
 - .7 Mounts to fixture or junction box through ½ inch (16 mm) trade size knockout.
 - .8 Digital Ballast/LED Driver Fixture Control Modules:
 - .1 Supports reporting of energy measurement to wireless hub at accuracy of plus/minus 2 percent or 0.5 W (whichever is higher).
 - .2 Single integral controller with Class 1 or Class 2 isolated digital output signal conforming to IEC 60929; capable of direct control without interface.
 - .9 Provides direct low-voltage control of up to 3 compatible digital ballasts/LED drivers.
 - .1 Electronically links a digital ballast/LED driver to a zone for both dimming and turning on/off.
 - .2 Electronically assigns occupancy/vacancy sensors for manual on/auto off and auto on/auto off control.
 - .3 Electronically assigns wireless control stations for manual local control.
 - .4 Electronically assigns daylight sensor for automatic daylight dimming.
 - .10 Supports reporting of energy measurement to wireless hub at accuracy of plus/minus 2 percent or 0.5 W (whichever is higher).
 - .1 Single low voltage dimming module with Class 1 or Class 2 isolated 0-10V output signal conforming to IEC 60929 Annex E.2; source or sink automatically configures.
 - .2 Provides 0-10 V control for up to 3 ballasts/LED drivers (1 A load at 120-277 V, 6 mA max control current).
 - .3 Rated for switching 0-10 V ballasts, LED drivers, or fixtures that conform with NEMA 410.
 - .1 General Requirements:
- .4 Wired wall dimmers and switches with wireless communication inputs

- .1 Provide air gap service switch to disconnect power to load for safe lamp replacement, accessible without removing faceplate.
- .2 Operates at the rated capacity across the full ambient temperature range including modified capacities for ganged configurations which require removal of fins.
- .3 Provide radio frequency interference suppression.
- .4 Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.
- .5 Dimmers: Provide full range, continuously variable control of light intensity.
- .6 Dimmers for Electronic Low Voltage (ELV) Transformers:
 - .1 Provide circuitry designed to control the input of electronic (solid-state) low voltage (ELV) transformers. Do not use dimmers that utilize standard phase control.
 - .2 Provide resettable overload protection that provides automatic shut-off when dimmer capacity is exceeded. Do not use protection methods that are non-resettable or require device to be removed from outlet box.
 - .3 Designed to withstand a short, per UL 1472, between load hot and either neutral or ground without damage to dimmer.
- .2 Dimmers for Magnetic Low Voltage (MLV) Transformers:
 - .1 Provide circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472.
 - .2 Magnetic low voltage transformers to operate below rated current or temperature.
 - .1 Electronic Switches:
 - .1 Listed as complying with UL 20, UL 508, and UL 1472.
- .5 Preset Smart Wall Dimmers and Switches with Wireless Communication Inputs.
 - .1 Communicates via radio frequency with up to ten compatible wireless control stations.
 - .2 Dimmer Control: Multi-function tap switch with small, raised rocker for dimmer adjustment.
 - .1 Rocker raises/lowers light level, with new level becoming the current preset level.
 - .2 Switch single tap raises lights to preset level or fades lights to off.
 - .3 Switch double tap raises light to full on level.
 - .4 Switch tap and hold slowly fades lights to off over period of 10 seconds.
 - .5 LEDs adjacent to tap switch indicate light level when dimmer is on, and function as locator light when dimmer is off.
 - .3 Switch Control: Switch single tap turns lights on/off.
 - .4 Dimmer High End Trim:
 - .1 Incandescent Dimmers: Minimum of 92 percent of line voltage.
 - .2 Dimmers for Electronic Low Voltage (ELV) Transformers: Minimum of 95 percent of line voltage.
 - .3 Dimmers for Magnetic Low Voltage Transformers: Minimum of 92 percent of line voltage.

- .6 Product(s) - Preset Smart Dimmers with Wireless Communication Inputs:
 - .1 Preset Smart Dimmer; Incandescent/halogen (600 W, 120 V), magnetic low voltage (600 VA/450 W, 120 V), dimmable CFL/LED (150 W, 120 V); multi-location capability using companion dimmers (up to nine companion dimmers may be connected); minimum load requirement.
 - .2 Preset Smart Dimmer; Electronic low voltage (600 W, 120 V); neutral required; multi-location capability using companion dimmers (up to nine companion dimmers may be connected); minimum load requirement.
 - .3 Companion Dimmer: Provides multi-location capability for compatible dimmers.
- .7 Product(s) - Electronic Switches with Wireless Communication Inputs:
 - .1 Electronic Switch; 6 A lighting/3 A fan (120 V); neutral required; multi-location capability using companion switches (up to nine companion switches may be connected); minimum load requirement.
 - .2 Electronic Switch; 8 A lighting/5.8 A fan (120 V); neutral required; multi-location capability using companion switches (up to nine companion switches may be connected); minimum load requirement.
 - .3 Electronic Switch; 8 A lighting/3 A fan (120 V); 8 A lighting (277 V); multi-location capability using companion switches (up to nine companion switches may be connected); minimum load requirement.
 - .4 Companion Switch: Provides multi-location capability for compatible electronic switches.
- .8 Wireless control stations
 - .1 Product(s):
 - .1 2-Button with Raise/Lower Control.
 - .2 Wallbox Adapter.
 - .2 Communicates directly to compatible RF receiving devices through use of a radio frequency communications link.
 - .3 Does not require external power packs, power or communication wiring.
 - .4 Allows for easy reprogramming without replacing unit.
 - .5 Button Programming:
 - .1 Single action.
 - .2 Toggle action.
 - .6 Includes LED to indicate button press or programming mode status.
 - .7 Mounting:
 - .1 Capable of being mounted directly to a wall under a faceplate.
 - .2 Faceplates: Provide concealed mounting hardware.
 - .8 Power: Battery-operated with minimum ten-year battery life.
 - .9 Finish: White
- .9 Wireless Hub
 - .1 Wireless hub without BACnet
 - .1 Surface-mount wireless hub.
 - .2 Integrated multicolor LED provides feedback on what mode the hub is in for simple identification and diagnosis.

- .3 Integrated processor and web server allows hub to set up and operate the system without any external connections to outside processors, servers, or the internet.
- .4 Utilizes Ethernet connection for:
 - .1 Networking up to 64 hubs together to create a larger system.
 - .2 Remote connectivity capabilities, including maintaining system date/time and receiving periodic firmware updates (requires internet connection).
- .5 A single hub or network of hubs can operate on either a dedicated lighting control only network or can be integrated with an existing building network as a VLAN.
- .6 Communicates directly to compatible RF devices through use of radio frequency communications link; does not require communication wiring; RF range of 71 feet (23 m) through walls to cover an area of 15836 square feet (1471 sq m) (device and hub must be on the same floor).
- .7 Communicates directly to mobile device (smartphone or tablet) or computer using built-in Wi-Fi, 2.4 GHz 802.11b/g; wireless range of 71 feet (23 m) through walls (device and hub must be on the same floor).
- .8 Does not require external Wi-Fi router for connecting to the hub.
- .9 Allows for system setup, control, and monitoring from mobile device or computer using web-based software:
- .10 Supports up to 700 total paired devices including compatible wireless sensors, wireless control stations, and wireless load devices.
- .11 Allows for timeclock scheduling of events, both time of day and astronomic (sunrise and sunset).
 - .1 Timeclock is integrated into the unit and does not require a constant internet connection.
 - .2 Retains time and programming information after a power loss.
- .12 Allows for control, monitoring, and adjustment from anywhere in the world (wireless hub internet connection required).
- .13 Uses RF signal strength detection to find nearby devices for quick association and programming without having to climb ladders.
 - .1 Association and setup does not require a factory technician to perform.
- .14 System using wireless hub(s) can operate with or without connection to the internet.
- .15 Supports energy reporting.
 - .1 Reports measured energy data for fixture control modules at accuracy of plus/minus 2 percent or 0.5 W (whichever is higher).
 - .2 Reports calculated energy data for junction box mounted modules at accuracy of 10 percent.
- .16 Supports automatic demand response for load shedding via:
 - .1 Local contact closure without need for separate interface.
- .17 Wireless hub can be firmware upgraded to provide new software features and system updates.
 - .1 Firmware update can be done either locally using a wired Ethernet connection or Wi-Fi connection, or remotely if the wireless hub is connected to the internet.
- .10 Web-Based Application:
 - .1 Accessibility and Platform Support:

- .1 Web-based; runs on most HTML5 compatible browsers (including Safari and Chrome).
- .2 Supports multiple platforms and devices; runs from a tablet, desktop, laptop, or smartphone.
- .3 User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.
- .4 Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).
- .5 Multi-level Password Protected Access: Individual password protection on both the integrated Wi-Fi network and web-based software.
- .6 WPA2 security for Wi-Fi communication with wireless hub.
- .2 System Navigation and Status Reporting:
 - .1 Area Tree View: Easy navigation by area name to view status and make programing adjustments through the software.
 - .2 Area and device names can be changed in real time.
- .3 Contact Closure Interface: Provide two contact closure inputs; accepts both momentary and maintained contact closures that can be used for automatic demand response.
- .11 Master Control Station
 - .1 Master control interface
 - .1 Screen: 246mm touch screen with anti reflective coating.
 - .2 Processor: 64-bit desktop class architecture.
 - .3 Up to 10 hour battery life
 - .4 802.11AC Wifi
 - .2 Mounting Bracket
 - .1 Mounting: Wall mounted
 - .2 Hardware: Tamper resistant
 - .3 Finish: Grey
 - .4 Options: Charging provisions.

2.4 INSTALLATION

- .1 Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130
- .2 Install products in accordance with manufacturer's instructions.
- .3 Sensor Locations:
 - .1 Sensor locations indicated are diagrammatic. Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage, in accordance with manufacturer's recommendations.
- .4 Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- .5 LED Light Engine/Array Lead Length: Do not exceed 100 feet (31 m).
- .6 Identify system components in accordance with Section 26 0553.

2.5 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Manufacturer's Full-Scope Start-Up Service is required.
- C. Manufacturer's Programming Service:
 - 1. Product(s):
 - a. All on site programming to be included.
 - .1 Verify connection of power wiring and load circuits.
 - .2 Verify connection and location of controls.
 - .3 Energize wireless hubs.
 - .4 Associate wireless remotes, and wall stations to load control devices.
 - .5 Provide calibration of sensors;
 - .6 Program timeclock schedules per approved sequence of operations.
 - .7 Configure load shed parameters per approved sequence of operations.
 - .8 Verify system operation control by control.
 - .9 Obtain sign-off on system functions.
 - .10 Train Owner's representative on system capabilities, operation, and maintenance.
 - .2 Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

2.6 ADJUSTING

- D. On-Site Scene and Level Tuning to make required lighting adjustments to the system for conformance with original design intent.

2.7 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment

2.8 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.47-M90(R2007), Air-Cooled Transformers (Dry Type).
 - .2 CSA C9-02(R2007), Dry-Type Transformers.
 - .3 CAN/CSA-C802.2-06, Minimum Efficiency Values for Dry Type Transformers.
- .2 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 dry type transformers 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 dry type transformers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 DESIGN DESCRIPTION

- .1 Design.
 - .1 Type: ANN.
 - .2 3 phase, kVA as indicated on drawings, 600V input, 120/208 V output, 60 Hz.

- .3 Voltage taps: 2x2.5% FCAN and 2x2.5% FCBN.
- .4 Insulation: Class 220, 150 degrees C temperature rise.
- .5 Basic Impulse Level (BIL): standard.
- .6 Hipot: standard.
- .7 Average sound level: standard
- .8 Impedance at 17 degrees C: standard
- .9 Enclosure: NEMA, removable metal front panel.
- .10 Mounting: as indicated.
- .11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .12 Copper windings.
- .13 Winding configuration to be as noted on drawings.
- .14 K4-Rated Transformers as indicated on drawings.
- .15 Voltage Regulation to be 4% or better.
- .16 Provide housekeeping pad.
- .17 Provide internal and external vibration isolators.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label 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 dry type transformers 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 Mount dry type transformers up to 75 kVA as indicated.
- .2 Mount dry type transformers above 75 kVA on floor.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.

- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.
- .9 Make conduit entry into bottom 1/3 of transformer enclosure.

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 dry type transformers installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit 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 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 equipment from [nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 EQUIPMENT

- .1 Fused disconnect switch: in accordance with Section 26 28 23 - Disconnect Switches, Non-Fused, rating as indicated.
- .2 Enclosed circuit breaker: in accordance with Section 26 28 16.02 - Moulded Case Circuit Breakers, rating as indicated.
- .3 Panelboard breaker type: in accordance with Section 26 24 16.01
- .4 Cabinet type 'A' for utility revenue metering: in accordance with Section 26 05 31- Junction, Pull Boxes and Cabinets, size as indicated.

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 equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative DCC 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 service equipment.
- .2 Connect to incoming service.
- .3 Connect to outgoing load circuits.
- .4 Install ground fault equipment.
- .5 Make grounding connections in accordance with Section 26 05 28 - Grounding - Secondary.
- .6 Make provision for power supply authority's metering.

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 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

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 Indicate on drawings:
 - .1 Floor 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.
 - .2 Include time-current characteristic curves for circuit breakers and fuses.

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 3 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 off ground, 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 Provide 150mm thick, rounded corners concrete housekeeping pad.
- .3 Rating: 347/600 V, 3 phase, 4 wire, 800A, short circuit current 65 kA (rms symmetrical).
- .4 Cubicle: exterior wall-mounted NEMA 4X, size as indicated.
- .5 Hinged access panels with captive knurled thumb screws.
- .6 Bus bars and main connections: 99.3% copper.
- .7 Bus from load terminals of main breaker to main lugs of distribution section.
- .8 Identify phases with colour coding.

2.2 MOULDED CASE CIRCUIT BREAKERS

- .1 Refer to specification section 26 28 12.02 – 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 #3/0AWG grounding cable.

2.4 FINISHES

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

2.5 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: "600 V."
 - .3 Main disconnect labelled: "Main Breaker".
 - .4 Branch disconnects labelled: "Big House", "Men's House", "Furloft", etc.

2.6 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 North West Bastion wall.
- .2 Connect main secondary service to line terminals of main breaker.
- .3 Connect load terminals of distribution's breaker's to feeders.
- .4 Check factory made connections for mechanical security and electrical continuity.
- .5 Run one grounding conductor 3/0 AWG bare copper in 25 mm conduit from ground bus to building ground.
- .6 Check trip unit settings 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 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

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

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 panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

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 panelboards for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location 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 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.

- .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 208V and 600V panelboards: bus and breakers rated for 14 or 65 kA (symmetrical) interrupting capacity or as indicated. Confirm MH fault level.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel.
- .11 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.
- .5 Lock-on devices for fire alarm, emergency and exit circuits. Paint breakers red for fire alarm panel.

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 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 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

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA C22.2 No.94.1-07, Enclosures for Electrical Equipment, Non Environment Considerations.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .3 The Munsell System of Colour Notation

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 electrical cabinets and enclosures 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 electrical cabinets and enclosures for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 MATERIALS

- .1 Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish to CAN/CSA C22.2, Munsell Notation 7.5GY3.5/1.5, size as indicated.
- .2 Entire enclosure to be capable of withstanding maximum impact force of 86 MN/m2 area without rupture of material.
- .3 Removable enclosure panels with formed edges, galvanized steel external fasteners removable only from inside enclosure.
- .4 Equip enclosure NEMA 4X with hot dipped galvanized mounting rails 1m adjustable horizontally and vertically to enable mounting of equipment at any location within housing.
 - .1 Rails: 14 mm holes and 50 x 14 mm slots on 100 mm centres for horizontal adjustment.
 - .2 Holes in side panel flanges in 60 mm increments for vertical adjustment.
- .5 Cover: tamperproof, bolt-on, domed to shed water.
- .6 Door: 3 point latching, with padlocking means.
- .7 Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, and vermin.
- .8 Enclosure construction such as to allow configuration of single or ganged enclosures.
- .9 Enclosure capable of being shipped in knocked-down condition.

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 electrical cabinet and enclosure 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 Assemble enclosure in accordance with manufacturer's instructions and securely mount on building structure with channels, supports and fastenings.
- .2 Mount equipment in enclosure.
- .3 Label electrical cabinets and enclosure to Section 26 05 00 - Common Work Results for Electrical.

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 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

- .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).

1.3 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 wiring devices 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 wiring devices] for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location 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 15A, 120V AC, premium specification grade, single pole, commercial decorator paddle type and complete with the following features:
 - .1 Terminal holes approved for #10 AWG wiring.
 - .2 Silver alloy contacts.
 - .3 Urea molding.
 - .4 Suitable for side and back wiring.
 - .5 Fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity for motor loads.
 - .6 Standard of acceptance: Arrow Hart 7601AM White. Other acceptable manufacturers: Pass & Seymour-Legrand, Hubbell, Bryant.
 - .7 Impact Resistant
- .2 Switches of one manufacturer throughout project.
- .3 Complete with pilot light as indicated. Pilot lights to be illuminated in the "off" position.
- .4 Acceptable manufacturer: Bryant, Arrow Hart, Pass and Seymour.
- .5 Not all switches are included in lighting control system.

2.2 RECEPTACLES

- .1 Duplex receptacles, NEMA No. 5-15 R, 125 VAC, 15 A, parallel slot, U ground, with the following features:
 - .1 Suitable for #10 AWG back and side wiring.
 - .2 Break-off links for use as split receptacles.
 - .3 Double wipe contacts and non-riveted grounding contacts.
 - .4 Aluminum yokes, blades or terminals or with CU/AL rating will not be accepted.
 - .5 Acceptable manufacturer: Arrow Hart #5262, Bryant #5262, Pass and Seymour #5262
- .2 Single receptacles NEMA No. 5-15R, 125V AC, 15A, U-ground, suitable for #10 back and side wiring.
- .3 Other receptacles with ampacity and voltage as required.
- .4 Receptacles of one manufacturer throughout project.
- .5 Colour of receptacles shall be as follows:
 - .1 White for normal power.
- .6 Duplex receptacles, NEMA No. 5-20 R, T slot, 125 VAC, U ground, with the following features:
 - .1 Nylon face.
 - .2 Suitable for #10 AWG back and side wiring.
 - .3 Break-off links for use as split receptacles.

- .4 Double wipe contacts and non-riveted grounding contacts.
- .5 Aluminum yokes, blades or terminals or with CU/AL rating will not be accepted.
- .6 Acceptable manufacturers: Bryant #5362, Arrow Hart #5362, Pass & Seymour #5362.
- .7 Duplex receptacles, NEMA No. 6-30 R, 250 VAC, with the following features:
 - .1 Nylon face.
 - .2 Suitable for #8 AWG back and side wiring.
 - .3 Double wipe contacts and non-riveted grounding contacts.
 - .4 Aluminum yokes, blades or terminals or with CU/AL rating will not be accepted.
- .8 Standard of acceptance: Pass & Seymour-Legrand #1801. Other acceptable manufacturers: Bryant, Arrow Hart.

2.3 SPECIAL WIRING DEVICES

- .1 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for weatherproof duplex receptacles.
- .2 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.
- .3 Provide special receptacles as required to suit specific equipment requirements as follows:
 - .1 30 amp, 125/250V, 3-pole, 4-wire receptacle NEMA #14-30R.
 - .2 20 amp, 125V, 2-pole, 3-wire universal receptacle NEMA #5-20RA.
 - .3 50 amp, 250V, 2-pole, 3-wire universal receptacle NEMA #6-50RA.
 - .4 Refer to floor plans for locations.
- .4 Ground fault circuit interrupting receptacle (GFCI), 15A, 125V, nylon face, feed-thru feature, contrasting colour band on reset button, screw terminals, white-coloured face.
Standard of acceptance: Pass & Seymour-Legrand 1595 White.
Other acceptable manufacturers: Bryant, Arrow Hart.
- .5 Ground fault circuit interrupting receptacle (GFCI), 20A, 125V, nylon face, feed-thru feature, contrasting colour band on reset button, screw terminals, white-coloured face.
Standard of acceptance: Pass & Seymour-Legrand 2095 White.
Other acceptable manufacturers: Bryant, Arrow Hart.

- .6 Ground fault circuit interrupter receptacle: Class A rated, CSA type 5-15R, 125V, 15A feed through rated to: CSA-C22.2 No. 144 with the following features:
 - .1 Specification grade.
 - .2 Nylon moulded housing.
 - .3 Decora style.
 - .4 Suitable for No. 10 AWG for side and back wiring.
 - .5 Solid state ground sensing device.
 - .6 Testing and reset buttons.
 - .7 Indicator light to show status of GFCI protection operation.
 - .8 Malfunction protection. Device cannot be reset if GFCI is non operational or unit is wired incorrectly.
 - .9 30mA trip level.
- .7 Ground fault circuit interrupter receptacle: Class A rated, CSA type 5-20R, 125V, 20A T-Slot feed through rated to: CSA-C22.2 No. 144 with the following features:
 - .1 Specification grade.
 - .2 Nylon moulded housing.
 - .3 Decora style.
 - .4 Suitable for No. 10 AWG for side and back wiring.
 - .5 Solid state ground sensing device.
 - .6 Testing and reset buttons.
 - .7 Indicator light to show status of GFCI protection operation.
 - .8 Malfunction protection. Device cannot be reset if GFCI is non operational or unit is wired incorrectly.
 - .9 30mA trip level.

2.4 METAL WHILE-IN-USE WEATHER PROTECTIVE COVER BOXES

.1 DEVICE TO MEET CEC FOR RECEPTACLES IN DAMP OR WET LOCATIONS.

DIECAST POWDER COATED ALUMINUM. VERTICAL OR HORIZONTAL AS INDICATED.

NEMA 3R RATING COMPLETE WITH GASKET, MOUNTING HARDWARE, DUPLEX RECEPTACLE INSERT AND GFCI RECEPTACLE INSERT LOCKABLE TO PREVENT ACCIDENTAL DISCONNECTS.

2.5 COVER PLATES

- .1 Provide cover plates for all wiring devices.
- .2 Cover plates from one manufacturer throughout project.
- .3 Coverplates for surface mounted receptacles and switches on exposed conduit systems shall be stainless steel 12mm raised type.
- .4 Stainless steel coverplates, thickness 1mm for wiring devices mounted in flush-mounted outlet box.
- .5 Cast gasketed coverplates for wiring devices mounted in surface-mounted cast Feraloy type conduit boxes.
- .6 Duplex cast aluminum spring-loaded weatherproof coverplates for exterior mounted wiring devices, flush mounted or surface mounted in FS or FD boxes.
- .7 Acceptable manufacturer: Pass and Seymour, Arrow Hart, Bryant.

2.6 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

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 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 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 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

- .1 Not used

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide fuse performance data characteristics for each fuse type and size. Performance data to include: average melting time-current characteristics.
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in storage cabinet.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Six spare fuses of each type and size installed.

Part 2 Products

2.1 FUSES - GENERAL

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.

2.2 FUSE TYPES

- .1 Class L fuses.
 - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type L2, fast acting.
- .2 Class J fuses.

- .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
- .2 Type J2, fast acting.
- .3 Class R -R fuses.
 - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
 - .2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .4 Class C fuses.

2.3 FUSE STORAGE CABINET

- .1 Fuse storage cabinet, manufactured from 2.0 mm thick aluminum 750 mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door finished in accordance with Section 26 05 00 - Common Work Results for Electrical.

Part 3 Execution

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
 - .1 Install rejection clips for Class R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.
- .5 Install spare fuses in fuse storage cabinet.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 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).

1.3 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 [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.
- .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.
 - .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title

- .2 End user's reference number
- .3 List of circuit breakers

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store circuit breakers off ground, indoors, in dry location 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: 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 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers with interchangeable trips as indicated.
- .6 Circuit breakers to have minimum 10kA symmetrical rms interrupting capacity rating.

2.2 THERMAL MAGNETIC BREAKERS

- .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 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 PAYMENT

- .1 Payment for field testing of ground fault equipment performed by Contractor in accordance with Section 01 29 83 - Payment Procedures: Testing Laboratory Services.

1.3 REFERENCES

- .1 CSA International
 - .1 CAN/CSA C22.2 No.144-M91(R2006), Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PG 2.2-1999(R2009), Application Guide for Ground Fault Protection Devices for Equipment.

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 ground fault circuit interrupters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Test and Evaluation Reports: submit test report for field testing of ground fault equipment to Departmental Representative and certificate that system as installed meets criteria specified.

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 ground fault circuit interrupters for incorporation into manual.

1.6 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, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect ground fault circuit interrupters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144.
- .2 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

- .1 Single pole ground fault circuit interrupter for 15A, 120V, 1 phase circuit c/w test and reset facilities.

2.3 GROUND FAULT PROTECTOR UNIT

- .1 Self-contained with 15 A, 120 V circuit interrupter and duplex receptacle complete with:
 - .1 Solid state ground sensing device.
 - .2 Facility for testing and reset.
 - .3 CSA Enclosure 1, surface mounted with stainless steel face plate.

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 ground fault circuit interrupters 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 not ground neutral on load side of ground fault relay.
- .2 Pass phase conductors including neutral through zero sequence transformers.
- .3 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and co-ordinate with Section 01 45 00 - Quality Control if required.
- .2 Arrange for field testing of ground fault equipment by independent testing laboratory before commissioning service.
- .3 Demonstrate simulated ground fault tests.

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

- .1 General

1.2 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.3 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.

1.4 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 disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect 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 Non-fusible, Horsepower rated disconnect switch in CSA enclosure, to CAN/CSA-C22.2 No.4 size as indicated.
- .2 Provision for padlocking in on-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.

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 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 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 RELATED REQUIREMENTS

- .1 Section 33 11 16.01.
- .2 Section 22.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.3 No. 4 Control of Electrochemical Corrosion of Underground Metallic Structures.
- .2 National Association of Corrosion Engineers (NACE)
 - .1 NACE SP0169, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets for cathodic protection and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate location of anodes, test positions, connecting cables, wire splicing details, installation procedures, power supply, hardware and accessories.

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:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 EQUIPMENT

- .1 Provide complete cathodic protection system to NACE SP0169, CSA 22.3 No.4 and comprising galvanic or sacrificial anodes with design life, of 25 years minimum.

Part 3 Execution

3.1 INSTALLATION

- .1 Install system including bonding as indicated.
- .2 Locate test stations in weatherproof housings.
- .3 Make joints and connections by means of thermit welding.
 - .1 Bond pipelines to structure.

3.2 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1-04, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005-07, Radio Frequency Lighting Devices.
- .6 Underwriters' Laboratories of Canada (ULC)

1.3 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 approval by Departmental Representative.
 - .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.
- .4 Submit application for Manitoba Hydro Power Smart Commercial Lighting Rebate along with all lighting shop drawing

1.4 QUALITY ASSURANCE

- .1 Provide mock-ups in accordance with Section 01 45 00 - Quality Control.
- .2 Provide lighting mock-up for room R5 with installation of Type B luminaire

1.5 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 DRIVERS

- .1 LED Drivers
- .2 Reliable and consistent operation
- .3 High efficiency >90%
- .4 Greater than 0.9 PF and Less than 20% THD
- .5 Greater than 50,000 hrs life time
- .6 5-year limited warranty
- .7 ROHS compliance
- .8 Safety approbations (UL, CSA, CE, ENEC, PSE, SELV or CQC)
- .9 Dimmable and Programmable.
- .10 Designed to meet the needs of LED lighting
- .11 Available in either dedicated input voltage or Intellivolt options
- .12 The Adjustable Output Current (AOC) feature
- .13 Specific dimmable versions to enable use of lighting controls to help increase energy saving through a wide variety of protocols, such as 0-10V

2.2 FINISHES

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

2.3 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire schedule.

2.4 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 Maintain integrity of building historic components: plaster ceilings, walls and floors, etc.

- .4 Confirm with Departmental Representative before any invasive procedure on building components if not indicated on drawings.

3.2 WIRING

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

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling, support luminaires from ceiling in accordance with local inspection requirements.
- .2 Ensure luminaires hardware is appropriate for plaster ceiling installations.

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 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.141-10, Emergency Lighting 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 emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4

1.6 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 - MENS HOUSE AND FURLOFT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.

- .2 Supply voltage: 120 V, AC.
- .3 Output voltage: 12 V DC.
- .4 Operating time: 30 minutes.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .10 Lamp heads: integral on unit and remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 5 W, minimum 340 lumen minimum output.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: white.
- .13 Auxiliary equipment:
 - .1 Ammeter.
 - .2 Voltmeter.
 - .3 Test switch.
 - .4 Time delay relay.
 - .5 Battery disconnect device.
 - .6 AC input and DC output terminal blocks inside cabinet.
 - .7 Shelf.
 - .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.

2.3 EQUIPMENT - BIG HOUSE

- .1 Refer to drawings and item .2 for Big House Emergency Lighting
- .2 Inverter
 - .1 Emergency lighting shall be provided by inverter unit equipment designed to operate designated LED fixtures on emergency power at their full nominal lumen rating during the full 30 minutes emergency discharge cycle. System output will be rated at 1.44 kilowatts for 30 minutes and provide fused output connections to the load. The system's voltage rating shall be VAC input/output nominal. The inverter unit shall allow for fused connected emergency fixtures to be normally on, normally off, switched or dimmed without affecting lamp

operation during a power failure. The nominal input/output voltage will be 120VAC.

- .2 Lamps operated: LED
- .3 Components: High-efficiency pure sine wave inverter
- .4 Temperature-compensated charger 12V oversized Valve Regulated Lead Acid (VRLA) battery
- .5 14-gauge steel sprinklerproof, sloped and rounded top
- .6 Input/Output voltage 120/120V 60Hz,
- .7 Replaceable output fuse protection
- .8 Battery long-life and maintenance free
- .9 Allowed to wire emergency fixtures at distances up to 1000 feet
- .10 Low Battery Voltage Disconnect
- .11 Unit standard with electronic lockout and brownout circuits
- .12 Unit to meet National Electrical Code and Life Safety Code Emergency Lighting Requirements.
- .13 Cabinet in factory white powder-coat paint finish
- .14 Unit to accept load to its full capacity when load feature power factor of 0.9 or more
- .15 Non audible auto-test. Interface available with minimum lost load detection of 10%
- .16 Unit to meets or exceed the requirements of CSA 141-15

2.4 REMOTE EMERGENCY LUMINAIRES - BIG HOUSE

- .1 General lighting as indicated on drawings

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 RELATED REQUIREMENTS

- .1 This Section covers items common to Sections of Divisions 26 and 28. These Sections supplement requirements of Division 1.

1.2 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.
 - .3 NBCC 2015

1.3 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.
- .3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

Part 2 Products

2.1 STANDARD UNITS

- .1 Illumination provided by borosilicate glass tubes, internally coated with zinc sulphide phosphor and filled with tritium gas
- .2 Minimum brightness at time of manufacture is 0.132 foot-lambert (0.452 cd/m²)
- .3 Heavy-duty ABS housing
- .4 Rugged, impact-resistant polycarbonate face
- .5 Spark-free construction
- .6 Universal direction capability, complete with universal mounting hardware
- .7 Suitable for extreme temperatures indoor applications
- .8 Life expectancy minimum of 10-year
- .9 Single or double face as required
- .10 Certified to standard UL924 (ULC-S572)
- .11 Pictogram Sign to include universal stencils (straight from here, left from here and right from here)

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 (FURLOFT)

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Maintain integrity of Heritage Building. Confirm in writing installation procedure with Departmental Representative before any invasive procedure if not indicated in documents.

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