

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Division 27 and Division 28 sections.

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 Canadian Standards Association (CSA)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .3 CAN/CSA C22.3 No. 1-10, Overhead systems
 - .4 CAN/CSA-C22.3 No. 7-10 (R2015), Underground Systems.
 - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2013, Standards Dictionary: Glossary of Terms and Definitions.
 - .3 National Electrical Manufacturer's Association (NEMA)
 - .1 NEMA 260-1996 (R2004), Safety Labels for Padmounted Switchgear and Transformers Sited in Public Areas.
 - .4 American National Standards Institute
 - .1 ANSI/NETA ATS-2009, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

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 and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS in accordance with Construction and Hazardous Materials Section.
- .3 Submit for review single line electrical diagrams under plexiglass and locate as indicated.
 - .1 Electrical distribution system in electrical room.
- .4 Submit fire alarm riser diagram, plus plan and zoning to Fire Marshall for review.

- .5 Submit for review fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.
- .6 Shop drawings:
 - .1 Refer to individual specification sections for shop drawing requirements.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Submit required number of copies of 600 x 600 mm minimum size drawings to authority having jurisdiction.
 - .6 If changes are required, notify Departmental Representative of these changes before they are made.
- .7 Certificates:
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment or material is not available, submit such equipment and material to authority having jurisdiction for approval by a certified agency of Standard Council of Canada (SCC) 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.
- .8 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.

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 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.
- .3 In addition to technical data the Electrical Contractor shall also include:
 - .1 Names, addresses and phone numbers of local supplier for items included in the maintenance manual
 - .2 Copy of reviewed shop drawings.
 - .3 Copy of Electrical Specifications.
 - .4 Names, addresses and phone numbers of Electrical Sub-contractors.
 - .5 Inspection certificates and verification reports.
 - .6 Letter or certificate of warranty.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material Delivery Schedule: Provide Departmental Representative with schedule within 2 weeks after award of contract for all long delivery items.
- .3 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .4 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect materials from damage to finish or material.
 - .3 Replace defective or damaged materials with new.

1.6 ADDENDA AND REVISIONS

- .1 All addenda, instructions and revisions issued during the tendering period shall become part of the Contract Documents and shall be included in the Tender, and shall take precedence over the previous instructions.

- .2 The Departmental Representative reserves the right to make revisions to the drawings during the period of construction and these shall take precedence over previously issued drawings. All revisions to the work shall be executed by duly authorized change orders with the amount of addition or deduction to the contract amount approved by the Departmental Representative before the execution of any work associated with the revision is undertaken.

1.7 SUBSTITUTIONS

- .1 It is the intent of these drawings to establish the required quality of materials. Where manufacturer names or catalogue references are used, it is done in order to establish the required quality, style, size or function. Products of other manufacturers will not be permitted after the signing of the contract. The decision as to suitability shall rest with the Departmental Representative.
- .2 Should the contractor propose to furnish material and equipment other than those specified, they shall submit a written request for any or all substitutions prior to the tender closing date. Such a request shall be accompanied by a complete description including manufacturer, brand name, catalogue number and technical data for all items. If requested by the Departmental Representative, the contractor shall submit for inspection a sample of the proposed item.
- .3 All material not meeting the specifications above shall not be allowed on the project site.
- .4 Substitutions affecting the design will not be permitted. Additional costs to any other trade as a result of a change or substitution by this contractor shall be the responsibility of this contractor.
- .5 The listing of a manufacturer as acceptable does not imply acceptance of all products of that manufacturer and only products meeting the specifications will be accepted.

1.8 SCOPE OF WORK

- .1 The Electrical Contractor shall furnish all labour, material, tools, appliances and equipment to entirely complete and provide the operation of the electrical systems.
- .2 The overall intention is to provide a functioning complete electrical installation in all aspects, and all items reasonably inferable as called for by the drawings and specifications, and by normally accepted good practice, notwithstanding that every item necessarily required may not be particularly mentioned. This Contractor shall fulfill his obligation and not take advantage of any unintentional errors or omissions, should any exist, to the detriment of the Owner's interest. The work shall include but not be limited to:
 - .1 Demolition of power feeding existing Buildings to be demolished
 - .2 Installation of power: new 5kV switch, new pad mount transformer and new 600V distribution panel mounted in enclosure.
 - .3 Installation of power distribution in new building.
 - .4 Branch circuit wiring.
 - .5 Installation of lighting system.
 - .6 Communication systems including data and networking.
 - .7 Installation of Fire alarm system and connection to Main Fire Alarm Panel.
 - .8 Installation of process controls.
 - .9 Start-up and commissioning of process controls.

- .10 Install High water level alarm beacon at outfall chamber. This work is inside the Institution secure area.
- .11 Coordination with other trades. See also Architectural, Structural, and Mechanical specifications and drawings.

1.9 ELECTRICAL DRAWINGS

- .1 The electrical drawings which constitute an integral part of this contract shall serve as working drawings. They indicate the general layout of the complete electrical system arrangements of feeders, circuits, outlets, switches, controls, panelboards, service equipment, communications, fire alarm systems, underground duct banks etc.
- .2 Field verification of scale dimensions on drawings is directed since actual locations, distances, and levels will be governed by the field conditions.
- .3 All discrepancies related to the electrical work shall be promptly brought to the attention of the Departmental Representative for clarification.

1.10 EXISTING CONDITION AND EXAMINATION OF DRAWINGS

- .1 The Electrical Contractor shall become completely familiar with the drawings and specifications, as well as construction methods of other trades related to the work to avoid possible interferences on the project. Should drastic changes be necessary to resolve such conflicts, this Contractor shall notify the Departmental Representative and secure written approval and agreement on the necessary adjustments before the installation is started.
- .2 Before submitting the tender, this Contractor shall visit the site and become familiar with site conditions, availability of storage space and all other factors that might influence the tender submittal.
- .3 The contractor shall determine all working conditions and rigidly comply. Conditions that require special consideration include but not limited to: Dust, Noise, Vibration, Water, Working hours, Continuity of power, Access to area of work, Physical protection of Owner's facility and equipment.
- .4 No extras will be allowed due to failure to account for site conditions or working conditions.
- .5 The exact rough in dimensions and connection points shall be determined from shop drawings and on-site measurements.

1.11 DISCREPANCIES

- .1 Bidders in preparing their tender, finding any errors, omission, or discrepancies in the drawings, specifications or other documents, or having any doubt in the intent or meaning of any part thereof, shall immediately notify the Departmental Representative, who will send written instructions or clarification to all bidders. Where such discrepancies exist, and it is evident that this Contractor could not have properly tendered without clarifications and where such clarification was not requested, not extra to the contract will be considered in order to have the installation properly made. The Departmental Representative will not be responsible for oral instruction.

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 nameplates for control items in English.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Equipment to be CSA certified. Where CSA certified equipment is not available, for approval by a certified agency of Standard Council of Canada (SCC) before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Process control wiring conduit: in accordance with Section 26 05 34 – Conduit, Conduit Fastenings and Conduit Fittings. All wiring and connections below 50 V which are related to control systems specified in mechanical sections or as shown on mechanical drawings shall be the responsibility of this contractor unless otherwise noted.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of inspection authorities and Consultant.
- .2 Signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

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

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: lamicoid 3 mm white finish face, black core (normal power), red face, white core (essential power), lettering accurately aligned and engraved into core, mechanically attached to equipment 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 to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five 25 letters per nameplate.
- .5 Nameplates for panelboards to indicate system and voltage characteristics, minimum interrupting capacity, panel amperage capacity.
- .6 Nameplates for breakers in switchboards to indicate panelboard being fed.
- .7 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .8 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .9 Terminal cabinets and pull boxes: indicate system and voltage.
- .10 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, 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 wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour. Colour scheme to match existing facility. Obtain colour coding from user.

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 switchgear and distribution enclosures light gray on normal power and red on emergency power to EEMAC-2Y-1.

2.10 COORDINATION STUDY

- .1 Arrange for the successful manufacturing company to carry out the following:
 - .1 Immediately upon award of the contract and prior to the manufacture of the switchboards, prepare a set of coordination curves on KE No. 336E time current characteristic graph paper and forward electronic copies (PDF Format) to the consultant for his approval. Make any changes as directed by the consultant at no additional charge to PWGSC.
 - .2 This shall be accompanied by supporting symmetrical as well as asymmetrical fault current calculation data with tabulations to verify protection of the various elements of the system under maximum and minimum fault conditions at the various points in the system.
- .2 The time-current characteristic curves for the following shall be plotted:
 - .1 The relays and fuses protecting the incoming service.
 - .2 Main and feeder protective devices at all voltage levels used in the distribution system.
 - .3 Protective devices associated with the largest motor in each MCC, the refrigeration compressor, and largest device in each distribution panel (where applicable).
 - .4 Transformer damage curves and cable damage curves: co-operate with, and obtain from, the utility and other manufacturers of equipment requiring protective devices to be used in the distribution system and prepare coordination curves as soon as possible. Be responsible, along with the other manufacturers of equipment connected to the distribution system, to ensure that the proper control and protective devices are selected such that they co-ordinate with all protective devices.
- .3 It shall be the responsibility of the switchgear manufacturer to examine the plans and specifications to ensure that the relays and protective devices being installed in the distribution system will provide satisfactory co-ordination.
- .4 Breaker frame sizes, sensors, delay types, power fuses, limiters, and fuses shall be provided in accordance with the approved co-ordination study and circuit breaker settings where applicable shall be provided so that the circuit breakers are set accordingly.

Part 3 Execution

3.1 INSTALLATION

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

3.2 NAMEPLATES AND LABELS

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

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule 40 steel pipe sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.
- .4 Use an approved fire rated sealant to caulk around all penetrations of conduit, cabling, etc. through fire rated assemblies.
- .5 Conceal conduits in finished areas, unless otherwise authorized. Run exposed conduit parallel to building lines and maintain maximum headroom.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 300 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 Telephone and data outlets: 300 mm.
 - .5 Wall mounted telephone outlets: 1200 mm.
 - .6 Card reader: 1200mm

- .7 Fire alarm manual pull stations: 1370 mm.
- .8 Fire alarm horns and strobes: 2100 mm.
- .9 Thermostats / Room Temperature Sensors: 1500 mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Electrical contractor shall provide a Short-Circuit and Protective Coordination study from the high voltage transformer to the 120/208V distribution for the new building.
- .2 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 CO-ORDINATION WITH OTHERS

- .1 Electrical contractor shall co-ordinate the installation of equipment to minimize inconvenience to Owner and other sub-contractors.
- .2 Work by other contractors will be done concurrently with work in this contract. This contractor shall schedule and arrange the work and store materials in co-operation so as to avoid interference with others.

3.8 CUTTING, PATCHING AND PAINTING

- .1 The contractor shall be responsible for all cutting required to complete the work shown on the drawing and described herein.
- .2 All holes through concrete or masonry shall be made by core drilling. Care must be taken to contain dust and debris.
- .3 Contractor shall be responsible to locate and coordinate access doors with general contractor. Access doors shall be supplied and installed by general contractor as per section 08 31 13.
- .4 Seal all holes and opening using an approved non-shrink fire proof compound. See also architectural sections.
- .5 The contractor shall neatly patch all surfaces cut or damaged as a result of this contract.
 - .1 All patching shall be of matching material and carried out by tradesmen trained and skilled in the work to be done.
- .6 The contractor shall re-paint all surfaces as required. All painting shall be carried out by skilled tradesmen.
- .7 All patching, painting and sealing shall be to the satisfaction of the Departmental Representative.

3.9 FIELD QUALITY CONTROL

- .1 Qualifications: Electrical work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction and as per the conditions of Provincial Act respecting manpower vocational training and qualification.

- .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician to perform specific task.
- .2 Permitted activities: determined based on the training level attained and demonstration of ability to perform specific duties
- .2 Health and Safety Requirements: Complete construction in accordance with occupational health and safety regulations.
- .3 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .4 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: 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.
- .5 Carry out tests in presence of Departmental Representative.
- .6 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .7 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.

3.10 MEDIUM VOLTAGE SYSTEM TESTING / COMMISSIONING

- .1 Station Ground Resistance
 - .1 After completion of construction, equipment shall not be energized until a testing/commissioning report on the complete installation is provided to NSP's Chief Electrical Inspector, and electrical inspection has been completed by the Inspection Department and all applicable checklists (see Electrical Inspection Bulletin B-36-000) have been submitted with the commissioning report. The testing/commissioning report is to be completed by an acceptable independent agency other than the installing electrical contractor. The report submitted by the agency must indicate that the High Voltage installation has been successfully tested in accordance with requirements of Section 36 of the CE Code and that the installation is ready to be energized.
 - .2 This contractor is responsible to hire the acceptable independent agency to do the testing/commissioning report and coordinate with them all the requirements of the Electrical Inspection Bulletin B-36-000.

3.11 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.

3.12 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.

3.13 RECORD DRAWINGS

- .1 Two sets of white prints shall be maintained for the exclusive purpose of recording deviations from that shown on the contract drawings. One set shall be kept up to date at all times. At the completion of the project the information shall be transferred to the second set of drawings. Both sets shall be turned over to the Departmental Representative.

3.14 GUARANTEE

- .1 Guarantee material and workmanship to be free from defect for a period of one (1) year or longer where specified otherwise, after issuing of the certificate of substantial completion.
- .2 Make good, at the Departmental Representative's convenience, all defects covered by this guarantee without additional cost to the Owner.

PWGSC
SEWAGE TREATMENT
UPGRADES
SPRINGHILL INSTITUTION
SPRINGHILL, NS
PROJECT NO. R.061876.001

COMMON WORK RESULTS
FOR ELECTRICAL

SECTION 26 05 00
PAGE 13

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 Common Work Results for Electrical.
- .2 Section 26 05 22 – Connectors and Terminations
- .3 Section 33 65 76 Direct Buried Underground Cable Ducts

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C68.3-97(R2006), Shielded and Concentric Neutral Power Cables Rated 5-46 kV.
- .2 Canadian Electricity Association (CEA)
 - .1 CEA Purchasing Specification WCWG-01: XLPE primary Cable Up to #4/0.
- .3 Insulated Cable Engineers Association (ICEA)
 - .1 ANSI/ICEA S-94-649-2013, Standard for Concentric Neutral Cables Rated 5 Through 46 kV.
- .4 Association of Edison Illuminating Companies (AEIC)
 - .1 AEIC CS8-13, Specification for Extruded Shielded Power Cables Rated 5 Through 46 kV.
- .5 American Society for Testing and Materials (ASTM) International
 - .1 ASTM B3-13 (2018), Standard Specification for Soft or Annealed Copper Wire.
 - .2 ASTM B8-11 (2017), Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- .6 Institute of Electrical and Electronics Engineers (IEEE)
 - .1 IEEE 386-2016, Standard for Separable Insulated Connector Systems for Power Distribution System Rated 2.5 kV Through 35 kV.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide manufacturer's printed product literature, specifications, data sheet 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 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

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 into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 CONCENTRIC NEUTRAL POWER CABLE (1001 – 5000 V)

- .1 Single copper conductor, size as indicated.
 - .1 Semi-conducting strand shield.
 - .2 Soft annealed copper wire to ASTM B3
 - .3 Concentrically stranded per ASTM B8
- .2 Insulation: cross-linked polyethylene rated 90 degrees C and 5 kV. Tree-retardant. ANSI/ICEA S-94-649 and CSA C-68.3 for 100% voltage level
- .3 Semi-conducting insulation cross-linked polyethylene (XLPE) shielding layer.
- .4 Copper neutral wires applied helically over insulation shield equivalent to 33 % full capacity.
- .5 Separator mylar tape over neutral wires.
- .6 Extruded PVC jacket rated minus 40 degrees C.

2.2 LOADBREAK BUSING WELL INSERT

- .1 Loadbreak bushing inserts 5 kV, 95 kV BIL, rated as indicated consisting of:
 - .1 Arc snuffer.
 - .2 Female contact, tin plated copper.
 - .3 Housing, moulded EDPM compound.
 - .4 Connector replaceable contact, copper.
 - .5 Lock ring.
 - .6 Grounding eye.

2.3 LOADBREAK ELBOW CONNECTORS

- .1 Loadbreak elbow connectors 5 kV, 95 kV BIL, rated as indicated to IEEE 386 Standard for Separable Connectors, consisting of:

- .1 Arc followers.
- .2 Male contact, tin plated copper.
- .3 Elbow connector housing, moulded EDPM compound.
- .4 Conductor contact, copper crimp type.
- .5 Hot stick eye, stainless steel bonded in elbow housing.
- .6 Voltage test point with hot stick removable cap.
- .7 Grounding eye moulded in elbow housing.
- .8 Moulded stress relief in elbow housing.
- .9 Moulded outer jacket conductive shield.

2.4 ELBOW TEST POINT MOUNTED FAULT INDICATORS

- .1 Test Point Mounted on loadbreak elbow, 400 A trip, weatherproof fault indicator with inrush restraint, voltage powered, current sensing, 1 ms response time, 30 sec delay on tripped flag display.

2.5 CABLE SEALING KIT

- .1 Cold shrink tube to seal cable at point of entry to loadbreak elbow.
- .2 Provides waterproof seal over exposed semiconductive portion of cable, end of elbow boot and cable jacket.
- .3 Rubber mastic sealing strips to seal around concentric neutral wires.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Use of qualified tradespersons for installation, splicing, termination and testing of high voltage power cables.
- .3 Engage an independent testing agent to test high voltage power cable. Submit test result and inspection certificate.

3.2 INSTALLATION

- .1 Install power cable in ducts or on pole lines as indicated and in accordance with manufacturer's instructions.
- .2 Install power cable in trenches as indicated.
- .3 Provide supports and accessories for installation of high voltage power cable.
- .4 Install stress cones, terminations and splices in accordance with manufacturer's instructions.
- .5 Install grounding in accordance with local inspection authority having jurisdiction.
- .6 Provide cable identification tags and identify each phase conductor of power cable.

- .7 Terminate cables with elbow connectors or, cable terminators as indicated and where necessary to complete the primary distribution system. Install all cable terminations to the manufacturers' specifications and instructions.

- .8 Install sealing kit on all cable entry points to load break elbows.
- .9 Install Test Point Mounted Fault Indicator on elbows where indicated on single line diagram.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 21 - Wires and Cables (0-1000V)

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18-98(R2009), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials 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 EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for copper conductors.
 - .2 Clamp for copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
- .4 Clamps or connectors for armoured cable, flexible conduit, TECK cable as required to: CAN/CSA-C22.2 No.18.
- .5 Joints required in connecting all wiring up to and including #8 AWG are to be made using twist-on connectors.
- .6 Joints for all other wiring shall be made using color-keyed compression type connectors followed by a layer of CSA approved vinyl plastic tape.

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 the Departmental Representative.

3.2 INSTALLATION

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

- .2 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
- .3 Install bushing stud connectors in accordance with EEMAC 1Y-2

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 Common Work Results for Electrical.
- .2 Section 26 05 20 Wire and Box Connectors – 0 – 1000V.
- .3 Section 26 05 34 Conduits, Conduit Fastenings and Conduit Fittings.
- .4 Section 33 65 76 Direct Buried Underground Cable Ducts

1.2 PRODUCT DATA

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

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: solid for #10 AWG and smaller, stranded for #8 AWG and larger. Minimum size: #12 AWG.
- .2 Copper conductors: size as indicated, with 600V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, RWU90 XLPE for wiring installed underground in conduit.
- .3 Conductors: all wiring shall be copper, unless indicated otherwise.
- .4 Neutral conductor insulated for 600V and shall be continuous with no fuses, switches, or breaks.
- .5 Maximum 2% voltage drop of line voltage for branch circuits. Voltage drop calculation shall be based on 80% of the circuit breaker rating for all branch circuits.
- .6 Branch circuit conductor sizes specified on drawings are the minimum required. Upsize branch circuit conductor sizes as required so that voltage drop is less than the maximum value permitted.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Type: ethylene propylene rubber.
 - .2 Cross-linked polyethylene XLPE.
 - .3 Rating: 600 V.

- .4 Armour: interlocking.
- .5 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .6 Fastenings:
 - .1 One hole malleable iron straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Threaded rods: 6 mm diameter to support suspended channels.
- .7 Connectors:
 - .1 Watertight approved for TECK cable.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

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

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 In underground ducts and trenches in accordance with applicable codes and standards.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.

- .2 Install cable exposed or concealed as indicated, securely supported by straps and hangers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 Common Work Results for Electrical.
- .2 Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CSA C22.2 No.41-13 (R2017), Grounding and Bonding Equipment (Tri-National Standard, With NMX-J-590-ANCE and UL 467).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide manufacturer's printed product literature, specifications, data sheet 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 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
- .3 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper long barrel compression connectors to CSA C22.2 No. 65-03 as required sized for conductors.

Part 3 Execution

3.1 INSTALLATION

- .1 Install, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2 No.41.
- .3 Do not install more than three (3) connections per junction box unless specifically permitted by Engineer in writing.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-2014, Qualifying Permanent Connections Used in Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide manufacturer's printed product literature, specifications, data sheet 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 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

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 manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Rod electrodes: copper clad steel, 19 mm diameter by 6 m long.

- .2 Conductors: bare, stranded, tinned soft annealed copper wire, size No. 4/0 AWG and 2/0 AWG for ground bus, electrode interconnections, metal structures, transformers, switchgear, motors, ground connections.
- .3 Conductors: insulated coloured green stranded tinned soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.
- .4 Bolted removable test links.
- .5 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
 - .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.
- .6 Wire connectors and terminations: as indicated.
- .7 Cable sheath isolating sleeves.

Part 3 Execution

3.1 INSTALLATION

- .1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.
- .2 Ground fences to grounding system independent of station ground.
- .3 Install connectors and Cadweld in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors during and after construction.
- .5 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Do not use bare copper conductors near un-jacketed lead sheath cables.

3.2 ELECTRODE INSTALLATION

- .1 Install ground rod electrodes. Make grounding connections to station equipment.
- .2 Install ground rod electrodes at transformer and switchgear locations.
- .3 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections as indicated to typical station equipment including: metallic water main, line sky wire, neutral. Non current carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cutout bases. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure. Sub-station fences, pothead bodies. Outdoor lighting.
- .2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.
- .3 Connect metallic piping (water, oil, air, etc.) inside station to main ground bus at several locations, including each service location within station. Make connections to metallic water pipes outside station to assist in reduction of station ground resistance value.

3.4 CABLE SHEATH GROUNDING

- .1 Bond single conductor, metallic sheathed cables together at both ends.
- .2 Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath.
- .3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Engage an independent testing agent to inspect grounding and perform ground resistance test before backfilling.
- .3 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction.
- .4 Perform test before energizing electrical system.
- .5 Provide step-and-touch potential calculations using measured station ground resistance measurements. Submit test result and inspection certificate before energizing electrical system.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

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.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect 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 underground water pipe.
- .2 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m long.
- .3 Insulated grounding conductors: green, copper conductors, size as indicated.
- .4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Compression 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.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 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.

- .7 Install separate ground conductor to outdoor lighting standards.
- .8 Connect building structural steel and metal siding.
- .9 Install grounding conductors in conduit and bond to EMT conduit.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .11 Bond single conductor, metallic armoured cables to cabinet at supply end.

3.3 EQUIPMENT GROUNDING

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

3.4 COMMUNICATION SYSTEMS

- .1 Install grounding connections for fire alarm in accordance with manufacturer recommendations.

3.5 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports, on walls of electrical rooms as indicated on drawings.
- .2 Use thermit weld or compression type connections to ground bus.

3.6 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 the Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, suspended.
- .2 Hot dipped galvanized steel supports systems shall be used in Aeration Building and exterior locations.
- .3 Stainless steel support systems shall be used in Headworks Building and UV Building.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole 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.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Departmental Representative.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 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.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on covers.

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 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 Section 26 05 00 Common Work Results for Electrical.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 MASONRY BOXES

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

2.3 PVC BOXES

- .1 Rigid PVC 'F' series boxes with 27mm conduit hub, reducer bushings, grounding clip and mounting feet for surface wiring devices.

2.4 FITTINGS - GENERAL

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

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.

- .2 All boxes shall be installed recessed/flush in cinder block walls unless indicated otherwise.
- .3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .4 For flush installations mount outlets flush with cinder block wall using masonry boxes.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .6 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .7 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

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. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.

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 PVC conduit: to CSA C22.2 No. 211.2.
- .2 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.
- .3 Use electrical metallic tubing (EMT) for concealed conduit and for surface conduit above 1.2 meters not subject to mechanical injury.
- .4 Use rigid galvanized steel conduit for surface conduit less than 1.2 meters above the floor.
- .5 Use threaded PVC coated rigid metal conduit for zone 1 hazardous locations.
- .6 Use rigid PVC conduit in trenches.
- .7 Use liquid tight flexible metal conduit for final connection to equipment such as pendant/chain mounted luminaire, motors and vibrating equipment where required.

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 code intervals.
- .4 Stainless Steel Threaded Rod shall be used in Headworks Building and UV Building while hot dipped galvanized steel is acceptable in all other locations. Threaded Rod shall be a minimum of 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 Two hole PVC pipe strap for PVC conduit.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 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 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in unfinished areas.
- .3 Use rigid PVC conduit throughout.
- .4 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .5 Minimum conduit size for lighting and power circuits: 21 mm.
- .6 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

- .7 Install fish cord in empty conduits.
- .8 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .9 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

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

3.4 CONCEALED CONDUITS

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

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

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

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Concrete pad: Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - .1 ANSI/IEEE 386-2016, IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV Through 35 kV.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C2-M91 (R2003), Single-Phase and Three Phase Distribution Transformers, Types ONAN and LNAN.
 - .2 CAN/CSA-C227.3-06(R2017), Low-Profile, Single-Phase, Pad-Mounted Distribution Transformers With Separable Insulated High-Voltage Connectors.
 - .3 CSA C227.4-06(R2017), Three-Phase, Pad-Mounted Distribution Transformers With Separable Insulated High-Voltage Connectors.
 - .4 CAN/CSA C802.1-2013 (R2018), Minimum Efficiency Values for Liquid-Filled Distribution Transformers.

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, and limitations.
- .3 Submit shop drawings and indicate:
 - .1 Anchoring method and dimensioned foundation template.
 - .2 Dimensioned cable entry locations.
 - .3 Dimensioned cable termination height.
 - .4 Identified internal and external component layout on assembly drawing.
 - .5 Insulating liquid capacity.
 - .6 Submit primary fuse and secondary breaker time-current characteristics.
- .4 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Certificates: submit production certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.5 Closeout Submittals:

.1 Provide operation and maintenance data for pad mounted distribution transformers for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Include insulating liquid maintenance data.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Ship transformers complete with first fill of liquid.

.2 Ship transformers pressurized with inert gas.

.3 Waste Management and Disposal:

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

1.5 MAINTENANCE

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

Part 2 Products

2.1 EQUIPMENT

.1 Three-phase dead front pad mounted distribution transformers: to CSA C227.4.

.2 Separable insulated connectors for power distribution systems above 600 V: to ANSI/IEEE 386.

.3 Oil filled pad mounted distribution transformers complete with primary and secondary cable compartments, primary un-fused disconnecting switch and viewing window, options and accessories to form complete factory assembled, self contained, steel fabricated for mounting on concrete pad.

.4 High voltage bushing wells for connection to distribution system through separable insulated connectors for dead front operation.

.5 Separable insulated connectors.

.6 Spade type low voltage terminals.

.7 Connectors for primary and secondary cables.

.8 Primary load break switch: 15 kV or 600 V, 300 A, 3-phase, two-position (on-off), gang-operated oil-immersed T-blade type switch for 1 up feed transformers. Switch with eye for hot stick operation shall be located in the high voltage compartment. Provide load break type lightning arresters.

.9 Primary protection: oil immersed, dual element bay-o-net type fuses in series with current limiting fuses inside tanks. Provide key interlock to ensure fuses are only accessible when de-energized.

.10 Separate padlocking for primary compartment door.

- .11 Load break inserts for elbow connectors.
- .12 Stays to hold compartment doors in 110 degrees open position.
- .13 Parking stand for each high voltage bushing.
- .14 Terminations and connectors suitable for loop feed.

2.2 TRANSFORMER CHARACTERISTICS

- .1 Primary voltage: 4,160 V or 600 V as indicated, 60 Hz, delta-connected, 3-phase.
- .2 Secondary voltage: 600/347 V or 208/120 V as indicated, wye-connected, 3-phase, 4-wire, neutral solidly grounded.
- .3 Capacity: As indicated.
- .4 Basic impulse level 95 kV.
- .5 Impedance: not less than 4%.
- .6 Transformer efficiency to meet or exceed CAN/CSA-C802.1.

2.3 VOLTAGE TAPS

- .1 Four-2.5% taps, 2-FCAN, 2-FCBN.

2.4 TAP CHANGER

- .1 Internally operated off-load tap changer, with provision for padlocking on 3 phase units.

2.5 ACCESSORIES

- .1 Liquid temperature thermometer with two sets of NO and NC of contacts.
- .2 Liquid level gauge with two sets of NO and NC of contacts.
- .3 Pressure relief device.
- .4 25 mm drain valve.
- .5 25 mm filler plug.
- .6 Voltage selector tap switch.

2.6 GROUNDING

- .1 Copper grounding bus size 50 x 6 mm.
- .2 Connectors for grounding conductors size as indicated.

2.7 FINISH

- .1 Finish tank exterior in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.8 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate showing information in accordance with CSA C2.
- .3 Provide name plate labels on both interior and exterior.

2.9 WARING SIGNS

- .1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.10 SOURCE QUALITY CONTROL

- .1 Submit to Departmental Representative standard factory test certificates of each transformer and type test of each transformer with high voltage accessories in accordance with CSA C2.

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 INSPECTION

- .1 Check factory made connections of transformer unit for mechanical security and electrical continuity.
- .2 Check transformer insulating liquid for correct quantity and specification according to manufacturer's instructions.

3.3 INSTALLATION

- .1 Ensure concrete pad is fully cured before transformer is installed.
- .2 Set and secure transformer unit in place, rigid, plumb and square.
- .3 Make connections.
- .4 Connect transformer unit ground bus to system ground.
- .5 Connect transformer unit ground bus to system ground.
- .6 Ensure care is taken to prevent contamination of liquid and components when field filling transformers.
- .7 Use only metal hose when field-filling transformer with oil: do not use rubber hose.
- .8 Set taps to produce rated secondary voltage at no-load.

3.4 FIELD QUALITY CONTROL

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

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

3.5 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 RELATED REQUIREMENTS

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

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.

Part 2 Products

2.1 DESIGN DESCRIPTION

- .1 Design 1.
 - .1 Type: ANN.
 - .2 3 phase, kVA as indicated, 600 V input, 120/208 V output, 60 Hz.
 - .3 Voltage taps: standard.
 - .4 Insulation: 150 degrees C temperature rise.
 - .5 Basic Impulse Level (BIL): standard.
 - .6 Hipot: standard.
 - .7 Average sound level shall meet CSA C9-02.
 - .8 Impedance at 17 degrees C: standard

- .9 Enclosure:
 - .1 Fabricated form sheet steel.
 - .2 Removable metal panels for access to tap connections
 - .3 Ventilated with NEMA enclosure to suit environment.
- .10 Mounting: floor or wall
- .11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .12 Copper windings.
- .13 Ground bar kit.
- .14 Equipped with vibrator isolator pads, if floor mounted.
- .15 Winding configuration to be as noted on drawings.
- .16 Voltage Regulation to be 4% or better.
- .17 Minimum K factor of 4.

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 INSTALLATION

- .1 Mount dry type transformers up to 75 kVA as indicated.
- .2 Mount dry type transformers above 75 kVA on floor on housekeeping pad.
- .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.

3.2 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 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.14-18, Industrial Control Equipment.
 - .2 CSA C22.2 No.31-2014, Switchgear Assemblies.
 - .3 CSA C22.2 No.58-M1989(R2015), High-Voltage Isolating Switches.
 - .4 CSA G40.20-13/G40.21-13(R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC G1-1-1958, Indoor and Outdoor Switch and Bus Insulators.
 - .2 EEMAC G8-3.3, Metal-Enclosed Interrupter 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 switchgear assembly and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Primary switchgear assembly to include:
 - .1 Enclosure.
 - .2 Load interrupter switches.
 - .3 Fuses
 - .4 Isolating switches.
 - .5 Busbar.
- .3 Shop Drawings:
 - .1 Submit drawing.
 - .2 Indicate on drawings:
 - .1 Floor anchoring method and dimensioned foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned cable termination height.
 - .4 Dimensioned position and size of busbars and details of provision for extension.

- .5 Dimensioned positions of main connections, including air clearances and support insulators.
- .6 Layout of internal and front panel components suitably identified.
- .7 Time current characteristics curves of protection devices.

.4 Certificates:

- .1 Submit manufacturer's test certificates.

.5 Sustainable Design Submittals:

.1 Construction Waste Management:

- .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- .1 Submit manufacturer's type test certificates indicating switchgear cubicles and components tested as integrated assembly.
- .2 Submit test procedures, at least 10 days prior to testing.
- .3 Submit production test results before equipment is shipped from factory.

1.6 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 Ship and store switchgear assembly in upright position.
 - .2 Keep doors locked and protect instruments from damage and dust.
 - .3 Ship channel base sills, anchoring devices in advance of switchgear.
 - .4 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .5 Store and protect switchgear assembly from nicks, scratches, and blemishes.
 - .6 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.

- .5 Packaging Waste Management: remove for reuse of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan.

1.7 SCHEDULING

- .1 Co-ordinate time-current characteristics of protective fuses.

1.8 EXTRA MATERIALS

- .1 Submit maintenance materials in accordance with 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 1 spare set of power fuses of each type installed.
- .3 6 of each type of indicator light bulbs installed.

Part 2 Products

2.1 MATERIALS

- .1 Switchgear assembly: to CSA C22.2 No.31.
- .2 Steel for cubicles: to CSA G40.21.
- .3 Insulators: to CSA C22.2 No.58.
- .4 Enclosure finish to ANSI C57.12.

2.2 PRIMARY SWITCHGEAR

- .1 Primary switchgear: outdoor, 5 kV, 100 A, 3 phase, short circuit capacity 350 MVA, 14 kA symmetrical, BIL 95 kV.

2.3 PRIMARY ENCLOSURE

- .1 Welded tamper resistant construction, live front style, free standing self supporting for pad mounting.
- .2 Panel grade sheet steel 11 gauge.
- .3 Heavy-duty stainless-steel hinges and hinge pins.
- .4 Four (4) ventilated compartments: switch and fuse compartments as indicated.
- .5 Compartment doors full height gasketed, 3-point latching, recessed door handle and padlock pocket.
- .6 Weather and corrosion resistant finish.
- .7 Provisions for cable entrance through the bottom in each of the four (4) compartments.
- .8 Provide a mimic bus on the exterior of the switchgear.
- .9 2-hole NEMA spades on switch terminals and fuse terminals to accommodate 600 A power cable terminator on underground cable.

- .10 Switch components to be completely encased in an inner grounded steel compartment.
 - .1 Component compartment to have floor of 11 gauge galvanized steel sheet.
 - .2 Roof to be undercoated with an insulating "no drip" compound.
- .11 Two (2) termination compartments.
 - .1 Viewing windows in termination compartments to provide visual verification of switch blade position c/w tamper proof covers.
 - .2 Full length steel barriers to separate adjoining termination compartments.
 - .3 Live front style equipment.
- .12 Ground bus for each cable termination to allow convenient grounding of concentric neutral cable.
- .13 Finish four-step baked on, phosphetizing, conductive zinc coating, corrosion resistant primer, polyester top coat. EEMAC-2Y-1 equipment Green.
- .14 Switch compartment door shall be equipped with viewing window with tamper-resistant cover. The window shall provide a visual check at switch blade positions for all three phases. Minimum window size: 20 mm x 250 mm. Include warning labels to CSA requirements.

2.4 LOAD INTERRUPTER SWITCH

- .1 Three pole, quick make, quick break assembly, stored energy operating mechanism manual operated.
- .2 Continuous full load rating of 600 A, interrupting rating of 400 A, fault closing duty cycle, two-time rating 22400 A asymmetrical, 12000 A RMS symmetrical. Short circuit withstand rating 12,000 A, 350 MVA rms symmetrical.
- .3 In air switching. Do not use SF6 type equipment.
- .4 Voltage rating: 15 kV, BIL 95 kV.
- .5 Externally operated.
- .6 Folding operating handle.
- .7 Grounding studs.

2.5 LIGHTNING ARRESTERS

- .1 Provide primary lightning arresters in accordance with Section 26 41 00.01 - Primary Lightning Arresters.

2.6 FUSES

- .1 Provide power fuses sized as indicated.

2.7 KEY INTERLOCKS

- .1 Provide key interlocks on switch and fuse compartment doors.
- .2 Provide loose matching type key interlock lock for field mounting on transformer doors.

- .3 Switchgear and padmount transformer doors shall be interlocked such that:
 - .1 There is no access to fuses in switchgear and padmount transformer until the switch is in de-energized position, and
 - .2 The switch cannot be placed in the closed position until the switchgear fuse compartment and padmount transformer compartment containing bay-o-net fused have been closed.

2.8 EQUIPMENT IDENTIFICATION

- .1 Identify equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplates:
 - .1 Switchgear designation: label - white plate, black letters, size 7, engraved.
 - .2 Individual cubicle designations: labels - white plate, black letters, size 7, engraved.

2.9 WARING SIGNS

- .1 Include warning signs in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.10 SOURCE QUALITY CONTROL

- .1 Departmental Representative will conduct plant inspection.
- .2 Departmental Representative will witness standard factory testing of complete switchgear assembly, including operation of switches, circuit breakers and controls.
- .3 Notify Departmental Representative in writing, 10 days prior to testing, that equipment is ready for inspection.

Part 3 Execution

3.1 INSTALLATION

- .1 Install pre-cast steel reinforced concrete manhole and install switchgear on manhole as indicated. Ensure concrete is fully cured before installation of switchgear.
- .2 Provide duct entries to each compartment.
- .3 Install primary grounding loop as indicated.
- .4 Set and secure switchgear assembly in place on top of concrete pad rigid, plumb and square as indicated.
- .5 Make field connections as indicated to manufacturers' recommendations.
- .6 Connect ground bus to ground loop as indicated.
- .7 Check factory made connections for mechanical security and electrical continuity.

3.2 FIELD QUALITY CONTROL

- .1 Perform visual inspection for loose connections and damages.

- .2 Operate switch closing and tripping mechanisms to verify correct functioning.
- .3 Check phase rotation of each feeder.
- .4 Check for grounding and neutral continuity between switchgear grounding and system neutral.

3.3 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for switchboards and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit maintenance materials in accordance with applicable specifications.
- .2 Provide spare parts as recommended by manufacturer for maintenance period of 2 years minimum.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with applicable specifications.
- .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 switchboards from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 Switchboard

- .1 Switchboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in switchboards 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 Front access only.
 - .3 Provide Wire way as required.
 - .4 Provide Main cell and distribution cell as per drawings.
 - .5 Voltage ratings as per drawings
 - .6 Bus and breakers (symmetrical) interrupting capacity as indicated on drawings.
 - .7 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.
 - .8 Switchboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
 - .9 MIMIC BUS, provide mimic bus on front of all switchgear, to give visual indication of normal positioning of metering components, breakers, interlocks and transfer scheme
 - .10 Minimum of 2 flush locks for each panel board.
 - .11 Two keys for each switchboard and key switchboards alike.
 - .12 Copper bus with neutral of same ampere rating of mains.
 - .13 Mains: suitable for bolt-on/bolt to breakers only.
 - .14 Trim with concealed front bolts and hinges.
 - .15 Interlocked Breakers were indicated.
 - .16 Trim and door finish: baked enamel.
 - .17 Complete with an integral 100kA Surge Protection Device (SPD) with LED status indication.
 - .18 Complete with an enclosed meter:
 - .1 Meter shall be enclosed in switchboard;
 - .2 Meter shall be capable of recording: minimum, average and maximum readings for current, voltage, power factor, frequency, watts, volta-amps reactive and volt-amps.
 - .3 Meter shall be c/w RJ45 connector and be accessible through TCP/IP and BACnet/IP protocols.
 - .4 Meter shall be compatible with existing Foreseer Enterprise Management Network.
 - .19 Main breaker :
 - .1 Size as indicated;
 - .2 Service entrance rated.
 - .20 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.
 - .21 Acceptable Manufacturers:

- .1 Eaton;
- .2 Schneider;
- .3 ABB;
- .4 Electrical Distribution to be one manufacturer throughout entire project.

2.2 Breakers

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Thermal, magnetic or electronic tripping as required by indicated rating, manufacturer's equipment selection and coordination study.
- .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 5% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Owner.
- .5 Lock-on devices for: fire alarm security exit and night light circuits.

2.3 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each switchboard size 8 engraved as indicated.
- .3 Nameplate for each circuit in distribution switchboards 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.

2.4 Finishes

- .1 Exterior Factory powder coated as per color requirements in section 26 05 00 (Color noted in primary column of conduit identification matching voltage of equipment.)
- .2 Supply 2 spray cans touch up paint.

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 switchboard installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

- .1 As indicated.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with applicable specifications.
 - .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 applicable specifications.
- .3 Waste Management: separate waste materials for recycling in accordance with applicable specifications

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.29, 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.

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.
 - .3 All provisional space shall be fully bussed and breaker ready.
- .2 Panelboards: bus and breakers rated for (symmetrical) interrupting capacity as indicated.

- .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 panelboard.
- .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 breakers as indicated.
- .5 Lock-on devices for fire alarm, emergency lighting, exit signage.

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 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

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on fire rated plywood. 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 TESTS

- .1 Test each branch breaker to verify that it controls the load indicated on the drawing and panel directory.

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 Section 26 05 00 - Common Work Results for Electrical.

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).

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.
- .3 Shop Drawings:
 - .1 Submit drawings for product.

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.

Part 2 Products

2.1 SWITCHES

- .1 General Purpose - 15 A, 120 V single pole switches.
 - .1 Manually-operated heavy duty specification grade AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle.

- .2 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .2 Wet Location - 15 A, 120 V single pole switches.
 - .1 Manually-operated weatherproof non-metallic lever switch with following features:
 - .1 Suitable for No. 10 AWG for back and side wiring.
 - .2 Weather proof Cover.
 - .3 Non-Metallic.
 - .3 Class 1 Division 1 Location - 20 A, 120-277 V single pole switches.
 - .1 Manually-operated heavy duty explosion proof tumbler switch with following features:
 - .1 Suitable for No. 10 AWG for back and side wiring.
 - .2 Malleable iron construction with internal sealing chamber constructed of copper free aluminum.
 - .3 13mm hub openings top and bottom of the housing for conduit connections.
 - .4 Single internal housing ground screw.
 - .4 Switches of one manufacturer throughout each area.

2.2 RECEPTACLES

- .1 Duplex receptacles, specification grade, CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 Ivory urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Class A rated ground fault circuit interrupter, duplex receptacle, Specification Grade, CSA Type 5-15R/5-20R, 125 V as indicated, to: CSA-C22.2 No.42 with the following Features:
 - .1 Impact resistant face and body
 - .2 Tamper Resistant
 - .3 Weather Resistant
 - .4 5mA trip level
 - .5 Suitable for No. 10 AWG for back and side wiring.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

- .3 Stainless steel, 1 mm thick cover plates cover plates, for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

2.4 WEATHERPROOF COVER PLATES

- .1 Exterior weatherproof, while in use cover, heavy duty, cast aluminum, corner hinge for horizontal or vertical mounting, gasketed enclosure for exterior use.
- .2 Weatherproof, while in use cover thermoplastic surface mounted gasketed cover for interior use.

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout area.

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .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 and to meet Canadian Electrical Code requirements.
- .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.

3.2 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.

PWGSC
SEWAGE TREATMENT
UPGRADES
SPRINGHILL INSTITUTION
SPRINGHILL, NS
PROJECT NO. R.061876.001

WIRING DEVICES

SECTION 26 27 26
PAGE 4

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

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 circuit breakers.
- .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit a 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.

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.
- .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 to have symmetrical RMS interrupting capacity rating as indicated.

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.
- .2 Provide all equipment, wiring, accessories, programming and commissioning required to operate and function on the existing grounding system.

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 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 Departmental Representative.

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.
- .2 Do not ground neutral on load side of sensor.
- .3 Make connections as indicated and in accordance with manufacturer's written recommendations.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Arrange for field testing of ground fault equipment by ground fault equipment manufacturer 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

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 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.

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

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Non-fusible, heavy duty, Horsepower rated disconnect switch in CSA enclosure, to CAN/CSA-C22.2 No.4 size as indicated.
- .2 Provision for padlocking in off switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.
- .6 Explosion proof (Zone 1) rated disconnect switch for installation in Hazardous location Zone 1.

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 INSTALLATION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 2-2000 (R2005): Electromechanical contactors and motor-starters.

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

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

Part 2 Products

2.1 MATERIALS

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

2.2 MANUAL MOTOR STARTERS

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

2.3 FULL VOLTAGE MAGNETIC STARTERS

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

2.4 VARIABLE FREQUENCY DRIVES

- .1 This specification describes the electrical, mechanical, environmental, and reliability requirements for three phase, variable frequency drives as specified herein and as shown on the contract drawings.
- .2 The variable frequency drives and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of IEC, UL, CUL, CSA, and NEMA.
- .3 When requested by the Departmental Representative the following product information shall be submitted: Descriptive bulletins, product sheets, typical harmonic currents

- .4 Operation and maintenance manuals shall include the following information: Instruction books, recommended renewal parts list, drawings and installation information.
- .5 The VFD shall be rated for 600 Vac. The VFD shall provide microprocessor-based control for three-phase induction motors. The controller's full load output current rating shall be based on 50°C ambient and 10kHz switching frequency below 40Hp and 3.6 kHz switching frequently 40 Hp and above to reduce motor noise and avoid increased motor losses.
- .6 The VFD shall be of the Pulse width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output VIA a two-step operation. Adjustable Current Source VFDs are not acceptable. Insulated Gate Bipolar Transistors (IGBT's) shall be used in the inverter section. Bipolar Junction Transistors, GTO's or SCR's are not acceptable. The VFD shall self-protect against over-temperature operating conditions.
- .7 The VFD shall have an efficiency, at full load and speed, that exceeds 95% for VFD below 15Hp and 97% for drives 15Hp and above. The efficiency shall exceed 90% at 50% speed and load.
- .8 The VFD shall maintain the line side displacement power factor at no less than 0.96, regardless of speed and load.
- .9 The VFD shall have a one (1) minute overload current rating of 150% and a 2 (two) second overload current rating of 250%.
- .10 The VFD shall be capable of operating any NEMA design B squirrel cage induction motor, regardless of manufacturer, with horsepower and current rating within the capacity of the VFD.
- .11 The VFD shall have an integral EMI/RFI filter as standard.
- .12 The VFD shall limit harmonic distortion reflected onto the utility system by utilizing the standard 3% nominal impedance integral ac three-phase line reactor.
- .13 The VFD shall be able to start into a spinning motor. The VFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFD shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.
- .14 Standard operating conditions shall be:
 - .1 Incoming Power: as shown on drawings, (+10% to -15%) and 60Hz (+/- 5Hz) power to a fixed potential DC bus level.
 - .2 Frequency stability of +/- 0.05% for 24 hours with voltage regulation of +/- 1% of maximum rated output voltage.
 - .3 Speed regulation of +/- 0.5% of base speed.
 - .4 Load inertia dependant carryover (ride through) during utility loss.
 - .5 Insensitive to input line rotation.
 - .6 Humidity: 0 to 95% (non-condensing and non-corrosive).
 - .7 Altitude: 0 to 3,300 feet (1000 meters) above sea level.
 - .8 Ambient Temperature: -15C to 50C.
 - .9 Storage Temperature: -40C to 70C.
- .15 Control Functions:

- .1 Frequently accessed VFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the VFD enclosure. The VFD shall have an alphanumeric programmable display with status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not acceptable, and particularly those that use alphanumeric codes and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.
- .2 The keypad shall include a Local/Remote pushbutton selection. Both start/stop source and speed reference shall be independently programmable for Keypad, Remote I/O, or Field Bus.
- .3 The keypad shall have copy / paste capability.
- .4 Upon initial power up of the VFD, the keypad shall display a start up guide that will sequence all the necessary parameter adjustments for general start up.
- .5 Standard advanced programming and trouble-shooting functions shall be available by using a personal computer's RS-232 port and Windows TM based software. In addition the software shall permit control and monitoring via the VFD RS232 port. The manufacturer shall supply a compact disk with the required software. An easily understood instruction manual and software help screens shall also be provided.
- .6 The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information.
- .16 The operator shall be able to scroll through the keypad menu to choose between the following:
 - .1 Monitor
 - .2 Operate
 - .3 Parameter setup
 - .4 Actual parameter values
 - .5 Active faults
 - .6 Fault history
 - .7 LCD contrast adjustment
 - .8 Information to indicate the standard software and optional features software loaded.
- .17 The following setups and adjustments, at a minimum, are to be available.
 - .1 Start command from keypad, remote or communications port
 - .2 Speed command from keypad, remote or communications port
 - .3 Motor direction selection
 - .4 Maximum and minimum speed limits
 - .5 Acceleration and deceleration times, two settable ranges
 - .6 Critical frequency avoidance
 - .7 Torque limit
 - .8 Multiple attempt restart function
 - .9 Multiple preset speeds adjustment

- .10 Catch a spinning motor start or normal start selection
- .11 Programmable analog output
- .12 DC brake current magnitude and time
- .13 PID process controller
- .18 The VFD shall have the following system interfaces:
 - .1 Inputs – A minimum of six (6) programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided.
 - .2 Outputs – A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1) programmable analog output shall be provided.
- .19 The VFD shall include the following protective features as a minimum: over-current, overvoltage, inverter fault, under-voltage, Input Phase loss, Output phase loss, under-temperature, over-temperature, Motor stalled, Motor over-temperature, Motor underload, Logic voltage failure, Microprocessor failure
- .20 The VFD shall provide ground fault protections during power-up, starting, and running. VFD's with no ground fault protection during running are not acceptable.
- .21 Diagnostic Features to include: Fault History, Record and log faults, Indicate the most recent first, and store up to 30 faults;
- .22 Communication card for interface with Ethernet IP control system.
- .23 The VFD enclosure shall be NEMA 1.
- .24 The VFD shall have complete front accessibility with easily removable assemblies.
- .25 Input Voltage: as indicated on drawings, +10% to -15%
- .26 Output rating as indicated for heavy duty application.
- .27 VFDs shall be wall mounted in the electrical room.

2.5 CONTROL TRANSFORMER

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

2.6 ACCESSORIES

- .1 Selector switches: heavy duty, oil tight as required.
- .2 Indicating lights: heavy duty, oil tight, type and colour as indicated.

2.7 FINISHES

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

2.8 EQUIPMENT IDENTIFICATION

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

Part 3 Execution

3.1 INSTALLATION

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

3.2 FIELD QUALITY CONTROL

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 12 13 - Liquid Filled, Medium Voltage Transformers.
- .3 Section 26 13 18 - Primary Switchgear Assembly To 15 kV

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE C62.11-2012, Standard for Metal-Oxide Surge Arresters for AC Power Circuits (1kV).
 - .2 ANSI/IEEE C62.1-1989, Standard for Gapped Silicon-Carbide Surge Arresters for AC Power Circuits.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide manufacturer's printed product literature, specifications, data sheet 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 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

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 into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Arrester component parts: to CAN/CSA-C233.1-87 (R2004) and ANSI/IEEE-C62.36-2016.
- .2 Arrester characteristics:
 - .1 Intermediate arrester.
 - .2 System highest voltage line to line: 4.16 kV.
 - .3 MCOV (maximum continuous operating voltage): 2.4 kV.
 - .4 Outdoor type.
 - .5 Ground lead disconnecter.
 - .6 Housing: polymer.

Part 3 Execution

3.1 INSTALLATION

- .1 Mount arresters inside switch gear / switching cubicles.
- .2 Connect line terminals to phase conductors.
- .3 From arrester ground terminal run No. 4 AWG copper ground wire to switchgear ground bus.

3.2 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
- .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.
 - .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.

Part 2 Products

2.1 DRIVERS

- .1 LED Driver:
 - .1 Rating: voltage as indicated 120 V, 60 Hz, for use with LED fixtures.

- .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
- .3 Power factor: minimum 95 % with 95% of rated lumens.
- .4 Type: solid state.
- .5 Input voltage range: plus or minus 10% of nominal.
- .6 Minimum starting temperature: minus 30 degrees Celsius at 90 % line voltage.
- .7 Mounting: integral with luminaire.

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 Switch locations as indicated on drawings were entering rooms:
 - .1 AutoON/AutoOFF (ManualON/ManualOFF)
 - .2 Passive infrared (PIR) detection
 - .3 White decora
 - .4 Vandall resistant
 - .5 120V, 60Hz
 - .6 Single latching relay 10A rated
 - .7 Adjustable time delay between 30s-30min
 - .8 Dual Pyrometers for true 180 degree view
 - .9 Light sensor (photocell) included for ambient light hold off feature
- .2 Wall mounted locations as indicated on drawings
 - .1 Passive infrared (PIR) detection
 - .2 Vandall resistant
 - .3 120V, 60Hz
 - .4 Lighting control kitted with power baseline voltage to low voltage
 - .5 Adjustable time delay between 30s-30min
 - .6 Dual Pyrometers for true 180 degree view
 - .7 Light sensor (photocell) included for ambient light hold off feature

2.4 LUMINAIRES

- .1 Luminaires as per Luminaire Schedule.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.

- .2 Provide adequate support to suit ceiling system.

3.2 WIRING

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

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling.
- .2 For obstructions in the luminaire layout, coordinate with other trades. Luminaire placement takes precedence over ductwork, piping, etc. Coordinate sprinkler head locations with luminaires to avoid all unnecessary interferences.

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.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

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.

Part 2 Products

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 V, AC.
- .3 Output voltage: 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.
- .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 Auxiliary equipment:
 - .1 Test switch.
 - .2 Time delay relay.
 - .3 Battery disconnect device.
 - .4 AC input and DC output terminal blocks inside cabinet.
 - .5 Bracket.
 - .6 RFI suppressors.
- .13 Emergency lighting equipment to be explosion proof (Zone 1) where required as indicated in luminaire schedule.

2.2 WIRING OF REMOTE HEADS

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

Part 3 Execution

3.1 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.

3.2 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 Section 26 05 00 Common Work Results for Electrical.

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.

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, cleaning procedures and testing.

Part 2 Products

2.1 EXIT SIGNS

- .1 Exit signs: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: as indicated
- .3 Style and Lamping: "LED Pictogram" with 'green Running Man'
- .4 Mounting: Wall or ceiling mounted as indicated by drawings.
- .5 Faceplates: Single or double faced with indicative chevrons as indicated by drawings.
- .6 Wire guards where necessary to protect sign from mechanical damage.
- .7 Operation: over 100,000 hours of continuous operation without relamping LED.
- .8 Supply voltage: as indicated.
- .9 Operating time: 30 minimum.
- .10 Recharge time: 12 hours
- .11 Battery: nickel cadmium, sealed, maintenance free.

- .12 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.
- .13 Solid state transfer circuit.
- .14 Signal lights: solid state, for 'AC Power ON' 'High Charge' condition.
- .15 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.
 - .1 Removable or hinged front panel for easy access to batteries.
- .16 Auxiliary equipment:
 - .1 Self-Diagnostic
 - .2 Lamp disconnect switch.
 - .3 Test switch.
- .17 Exit signs to be explosion proof (Zone 1) where required as indicated in luminaire schedule.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.46-M1988(R2006), Electric Air-Heaters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 250-08, Enclosures for Electrical Equipment (1000 V Maximum).

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 unit heaters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.

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 unit heaters for incorporation into manual.

Part 2 Products

2.1 UNIT HEATERS

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Fan type unit heaters with built-in high-heat limit protection.
- .3 Fan motor: totally enclosed with resilient mount.
 - .1 Built-in fan motor thermal overload protection.
- .4 Hangers: as indicated.
- .5 Elements: mineral insulated copper coated steel sheath with aluminum, continuous helical brazed fins.

- .6 Refer to heater schedule for additional requirements.
- .7 Unit heaters to be explosion proof (Zone 1) where required as indicated in heater schedule.

2.2 CONTROLS

- .1 Refer to heater schedule for requirements.

Part 3 Execution

3.1 INSTALLATION

- .1 Suspend unit heaters from ceiling or mount on wall as indicated.
- .2 Install thermostats in locations indicated.
- .3 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

3.3 PROTECTION

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

END OF SECTION