

- Part 1            General
  - 1.1            RELATED SECTIONS
    - .1            Division 01 – General Requirements.
  - 1.2            REFERENCE STANDARDS
    - .1            Canadian Standards Association (CSA International)
      - .1            C22.1-18, Canadian Electrical Code (CEC), Part 1 (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
      - .2            C22.3 No. 7-15, Underground Systems.
      - .3            CAN3-C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
      - .4            Z462-15, Workplace Electrical Safety.
    - .2            Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
      - .1            EEMAC Y1-2-1979, Performance Specifications for Finishing Systems for Outdoor Electrical Equipment.
      - .2            EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
    - .3            Institute of Electrical and Electronics Engineers (IEEE)
      - .1            IEEE C37.2-2008, Standard for Electrical Power System Device Function Numbers, Acronyms, and Contact Designations.
      - .2            IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
    - .4            National Research Council of Canada
      - .1            National Building Code of Canada (NBCC) 2015.
  - 1.3            DEFINITIONS
    - .1            Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
  - 1.4            ACTION AND INFORMATIONAL SUBMITTALS
    - .1            Submit in accordance with Division 01 – General Requirements.
    - .2            Submit WHMIS SDS in accordance with Division 01 – General Requirements.
    - .3            Submit to Technical Safety, Department of Labour and Advanced Education, necessary number of drawings and specifications for examination and approval prior to commencement of work. Pay all associated fees.
    - .4            Submit as-built single line electrical diagrams for review. Final diagrams are to be provided under plexiglass and be securely mounted to wall in main electrical room.

- .5 Shop drawings:
  - .1 Submit manufacturer shop drawings of all products and equipment.
  - .2 Part numbers for submitted products and equipment **to be clearly highlighted, boxed or arrowed** with all required accessories and components indicated.
  - .3 Submitted information must be specific, detailed and relevant to the project. Bulk, generic information is not acceptable.
  - .4 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 coordinated installation.
  - .5 Identify circuit terminals on wiring diagrams and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .6 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .7 If changes are required, resubmit corrected shop drawings.
  - .8 Shop drawings to be submitted electronically:
    - .1 Shop drawings to be submitted in PDF format, legible and clear.
    - .2 Shop drawings to be grouped by specification section, with one PDF file per specification section. The file name to indicate the section number and name, i.e. "26 28 23 Disconnect Switches Rev0.PDF" with resubmissions appended Rev1, Rev2, etc.
    - .3 Supplemental information not previously submitted to be identified as follows: "26 28 23 Disconnect Switches Supplement 1.PDF", Supplement 2, etc.
    - .4 A cover sheet is to be incorporated into each PDF submission and indicate the project name and number, specification section number and name, the Contractor's name, supplier's name, date submitted, Contractor's stamp and signature identifying that the Contractor has reviewed the information prior to submission for correctness and completeness. Sufficient white space (minimum of ¼ page) is to be left for the Departmental Representative's stamp and comments.
    - .5 Electronic shop drawing transmittal forms, where provided, must be submitted as separate PDF files and not bound in with the shop drawings.
- .6 Certificates:
  - .1 Provide CSA certified equipment and material.
  - .2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of Work, load balance report as described in PART 3 – FIELD QUALITY CONTROL.
  - .6 Submit, upon completion of Work, Contractor's guarantee and warranty certificates in accordance with Division 01 – General Requirements.

- .7 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to the Departmental Representative.
  - .7 Manufacturer's Field Reports: submit manufacturer's written report to the Departmental Representative within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 – FIELD QUALITY CONTROL.
  - .8 Upon completion of project, submit as-built drawings and maintenance manuals in accordance with Division 01 – General Requirements.
- 1.5 CLOSEOUT SUBMITTALS
- .1 Submit in accordance with Division 01 – General Requirements.
  - .2 Operation and Maintenance Data:
    - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
    - .2 Operating instructions to include following:
      - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
      - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
      - .3 Safety precautions.
      - .4 Procedures to be followed in event of equipment failure.
      - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
    - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
    - .4 Post instructions where directed.
    - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
    - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.
- 1.6 QUALITY ASSURANCE
- .1 Quality Assurance: in accordance with Division 01 – General Requirements.
  - .2 Qualifications: electrical work to be carried out by qualified, licensed electricians or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.
    - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
    - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
    - .3 Ratio must not exceed one apprentice to one licensed electrician.

1.7 SCHEDULE

- .1 Note that the Departmental Representative intends to carry on business as usual and work activities must be coordinated to maintain electrical services in occupied areas. Provide any required temporary work.
- .2 Work activities which disrupt occupants of the building, such as excessive noise caused by drilling of walls, floors or ceilings must be approved and scheduled in writing with the Departmental Representative at least 48 hours in advance and done outside normal working hours.
- .3 All power shutdowns which affect building occupants or building operation must have prior approval of Departmental Representative and must be scheduled in writing at least 10 working days in advance with the Departmental Representative. All power shutdowns must be taken outside of normal working hours. Hours of work at the building are Monday to Friday, 6:00am to 6:00pm.
- .4 Overtime work and work outside normal work hours deemed necessary to accomplish scheduling are the responsibility of the Contractor and must meet the requirements of the Department of Post-Secondary Education, Training and Labour. All costs resulting from such overtime work must be included in the Contractor's total tender price.
- .5 Departmental Representative may require work to be done in phases. Refer to Division 01 – General Requirements for additional information and requirements.

1.8 ESSENTIAL SERVICES

- .1 Electrical and communication services including fire alarm, emergency and exit lighting, are considered essential services and must be maintained in operation at all times.
- .2 Should interruptions to these services be deemed absolutely necessary they must be approved and scheduled in writing with the Departmental Representative at least 10 days in advance. All interruptions must be taken outside of normal work hours. Hours of work at the building are Monday to Friday, 6:00am to 6:00pm.
- .3 Interruptions must be taken when acceptable to the Departmental Representative and may include weekday and weekend nights.
- .4 If an interruption in an essential service is taken, work must progress continuously until the service is restored.

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 [and labels] for control items in English and French.

.4 Use one nameplate or label for both languages.

## 2.2 MATERIALS AND EQUIPMENT

.1 Provide material and equipment in accordance with Division 01 – General Requirements.

.2 Material and equipment to be CSA certified prior to shipping to site. Where CSA certified material and equipment is not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 – ACTION AND INFORMATIONAL SUBMITTALS. For retrofit of existing service entrance boards, provide CSA certification from agency approved in the Province of Nova Scotia prior to energization.

.3 Factory assemble control panels and component assemblies.

.4 Where electrical equipment rooms are sprinklered in accordance with the National Building Code of Canada, the electrical equipment contained in such rooms is to have enclosures which comply with Canadian Electrical Code Rule 26-008.

## 2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and coordination responsibilities related to motors, equipment and controls, as indicated. Verify size, location and wiring requirements of all equipment with appropriate trade, reviewed shop drawings and site conditions prior to rough-in.

.2 Provide control wiring and conduit, except for conduit, wiring and connections below 50V which are related to control systems specified in mechanical sections and shown only on mechanical drawings.

## 2.4 ACCESS DOORS

.1 Supply access doors for furred ceilings or spaces for access to junction boxes, servicing equipment and accessories; or for inspection of safety, operating or fire devices for installation under Section erecting the walls or ceilings. Access doors to be flush mounted, 600 mm x 600 mm for body entry and 300 mm x 300 mm for hand entry unless indicated otherwise. Doors to open 180 degrees, have rounded safety corners, concealed hinges, gaskets as required and anchor straps. Screwdriver latches to be provided for low security areas and key latches provided where tampering is a concern. Steel to be prime coated.

## 2.5 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction and Departmental Representative.

.2 Decal signs, minimum size 175 x 250 mm.

2.6 WIRING TERMINATIONS

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

2.7 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .1 Nameplates: plastic laminate lamicaid 3 mm thick plastic engraving sheet, matte white finish face, black core, lettering accurately aligned and engraved into core, attached with self-tapping screws or double-sided tape.
  - .2 Sizes as follows:

NAMEPLATE SIZES

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

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be in English and approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets, junction and pull boxes to indicate system and/or voltage characteristics.
- .6 Transformers: indicate designated name of equipment, capacity, primary and secondary voltages.
- .7 Nameplates installed on distribution panelboards, motor control centres and splitter troughs shall indicate the following:
  - .1 Designated name of equipment.
  - .2 Voltages, number of phases and wires.
  - .3 Overcurrent protection device rating.
  - .4 Designation of power source.
  - .5 The following is an example:

**PANEL A – 120/208V – 3PH – 4W  
FED FROM 100A BKR IN PANEL DP1**

- .8 Nameplates installed on combination starters, magnetic starters, variable frequency drives, manual starters and all various system controls, control panels, contactors, disconnect switches, and large junction and pull boxes shall contain the following information:
- .1 Designated equipment tag and description of equipment.
  - .2 Voltage(s), number of phases.
  - .3 Designated name of power source.
  - .4 Branch circuit breaker number(s) where possible.
  - .5 The following is an example:

**CP-1 HEATING CIRCULATING PUMP  
600V – 3PH, FED FROM MCC #1**

- .9 All junction and/or pull boxes (volume less than 8500 cu cm) shall be marked with an indelible ink marker to designate the circuit number of enclosed wiring, the designated panel name and electrical characteristics where applicable.
- .10 Install an additional nameplate on all, or any piece of electrical equipment, or apparatus, i.e. Main Switchboard, CDP panels, panelboards, motor control centres, and fusible switches, etc. that may contain overcurrent devices, i.e. circuit breakers and/or fuses, that have been designed for, and incorporate an interrupting capacity sized “larger” than 10 KAIC.

Example:

<b>Minimum interrupting capacity of breakers installed in this panel is to be not less than 22 KAIC</b>	<b>Minimum interrupting capacity of fuses installed in this MCC is to be not less than 100 KAIC</b>
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2.8 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, indicating panel and circuit number; i.e., A-1. Normal ground circuits to have ground, neutral and phase wires identified with black on white background tape. Tape to be preprinted vinyl, self-adhesive. Circuits to be identified at both ends and at all pull and junction boxes.
- .2 Use coloured plastic tapes to identify feeders on both ends of conductors and at junction and pull boxes if conductor insulation colours are other than red, black, blue, white and green.
- .3 Maintain phase sequence and colour coding throughout.
- .4 Colour coding: to CSA C22.1.
- .5 Use colour coded wires in communication cables, matched throughout system.

2.9 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.
- .4 Review existing conduit and cable identification on site with Departmental Representative and match existing colour coding.
- .5 Colour coding legend to be provided under plexiglass and be securely mounted to wall in main electrical room adjacent single line electrical diagram.

	<u>Prime</u>	<u>Auxiliary</u>
250V to 749V Normal	Blue	
50V to 249V Normal	Green	
Controls	Brown	Orange
Data (incl. fiber, multimedia)	White	Yellow

2.10 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.
  - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

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 CSA C22.3 No.1 except where specified otherwise.

3.2 VAPOUR BARRIER PENETRATIONS

- .1 Penetrations through vapour barriers shall be effectively sealed to maintain the integrity of the vapour barrier.



3.3 CUTTING AND PATCHING

- .1 Provide cutting, coring and drilling for installation of electrical services. Hole sizes to be kept to a minimum. Restore and make good surfaces to pre-construction condition.

3.4 FIRE STOPPING

- .1 Supply and install ULC/cUL listed elastomeric fire-stopping and smoke seal materials around cable, conduit and tray openings and inside of sleeve penetrations to maintain firestop system rating equal to assembly.
- .2 Installation of fire-stopping and smoke seal materials and components to be in accordance with ULC/cUL certification and manufacturer's instructions.

3.5 NAMEPLATES AND LABELS

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

3.6 CONDUIT AND CABLE INSTALLATION

- .1 Prior to rough-in, coordinate locations of conduit runs with other trades. Do not block access to valves and devices requiring access by operating and maintenance personnel.

3.7 LOCATION OF OUTLETS AND EQUIPMENT

- .1 Verify size, location and wiring requirements of equipment with appropriate trade, reviewed shop drawings and site conditions prior to rough-in.
- .2 Maintain working clearances around all equipment in accordance with CSA C22.1, Canadian Electrical Code (CEC).
- .3 Change location of outlets, equipment and connections at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

3.8 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centerline of equipment.
- .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 Panelboards: 1500 mm or as required by Code.
- .4 Where there are existing outlets or equipment, match existing mounting heights except where required otherwise to meet current codes and standards.

### 3.9 COORDINATION OF PROTECTIVE DEVICES

- .1 Provide a Short-Circuit and Protective Device Coordination Study from the Utility connection to the 120/208 V distribution level in the Holland Building electrical rooms (new and existing) and in the Murray Building electrical room. TCC curves to show coordination on log-log graph at the 600 V level.
- .2 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as indicated in the Protective Device Coordination Study.
- .3 Provide an Arc-Flash Analysis in conjunction with the Protective Device Coordination Study to determine the arc-flash boundary and personnel protective equipment requirements in accordance with the latest adopted CSA Z-462. Provide warning labels to suit.

### 3.10 FIELD QUALITY CONTROL

- .1 Load Balance:
  - .1 Measure phase current to panelboards with typical loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Division 01 – General Requirements.
  - .1 Power and distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from distribution panels.
  - .3 Insulation resistance testing:
    - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
    - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
    - .3 Check resistance to ground before energizing.
- .3 Notify Departmental Representative five days in advance of equipment and system testing and verification. Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.11 SYSTEM STARTUP

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Division 01 – General Requirements.
- .2 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 C22.1-18, Canadian Electrical Code (CEC), Part 1 (24<sup>th</sup> Edition).
  - .2 Z462-15, Workplace Electrical Safety.

1.3 DESCRIPTION OF WORK

- .1 In general, work of this Section consists of, but is not limited to, the complete removal of all obsolete or abandoned electrical, communications and electronic safety & security services, equipment and materials in the area to be renovated including services associated with obsolete or abandoned mechanical systems. It also covers alterations to existing services affected by the renovations.
- .2 All removal or alteration work of electrical construction to be done in accordance with the safety standards outlined in the Canadian Electrical Code and CSA Z462.

1.4 SITE SURVEY

- .1 Prior to Tender submission, visit the site and survey and quantify the extent of the removals/alterations required for this contract and include for all costs in the total tendered price. Any existing conditions information indicated on the drawings is for general guidance only.
- .2 In conjunction with site visit, review civil and electrical drawings and include all costs due to existing conditions in total tendered price.

1.5 PROTECTION

- .1 Protect existing equipment from debris, dust and environmental conditions.
- .2 The Contractor is responsible for any damages to existing structure as a result of the work.

1.6 SALVAGE MATERIAL

- .1 Materials and equipment identified as being reused are to be taken down, stored, cleaned, re-installed, etc. as required to allow for new construction.
- .2 Identify any damaged equipment or materials intended for reuse prior to demolition and point out deficiencies to the Departmental Representative at that time.

- .3 Prior to demolition, Departmental Representative will arrange site tour and identify any items or equipment which are to be set aside as directed for future use by Departmental Representative.
- .4 All other materials and equipment removed under work of this Section becomes the property of the Contractor for disposal off the property.

Part 2 Products

NOT APPLICABLE

Part 3 Execution

3.1 GENERAL REMOVALS

- .1 Remove all obsolete or abandoned electrical, communications and electronic safety & security services, equipment and materials including device boxes, wire and conduit, except those designated for reuse.
- .2 Install blank coverplates on all empty device boxes that remain.
- .3 Remove services associated with obsolete or abandoned mechanical systems.
- .4 Coordinate work of this Section with other trades.
- .5 Schedule all removal work with the Departmental Representative. Do not disrupt building operations except as permitted by the Schedule.
- .6 Any existing conduit, wiring, boxes or equipment that is to remain in service is to be properly supported as required by the CEC. Any additional hangers, straps or fasteners required are to be supplied under this contract.
- .7 Make alterations to existing electrical services as required and make good all circuits affected by the renovations.
- .8 Any existing electrical circuits and/or equipment that are interrupted during construction to accommodate alterations but are to remain in service are to be reconnected and circuits made good.
- .9 Any relocating of existing equipment and any rerouting of existing wire and conduit to coordinate with new work or as required to meet current standards, to be included in total tendered price.

3.2 EXISTING CEILINGS

- .1 Remove and reinstall existing ceilings as required of work.
- .2 Prior to removal, photograph and document existing conditions and noted damage.

- .3 Replace ceiling tiles damaged during installation with new to match existing.

### 3.3 CUTTING

- .1 Cutting required for removals and alterations to be to the approval of the Departmental Representative and performed with appropriate power tools.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 C22.2 No.18.3-12, Conduit, Tubing and Cable Fittings (Tri-National Standard with ANCE NMX-J-017 and UL 514B).
  - .2 C22.2 No.65-13, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01 – General Requirements.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Division 01 – General Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in clean, dry, well-ventilated location and in accordance with manufacturer's recommendations.
  - .2 Store and protect wire and box connectors from damage.
  - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Crimp style wire connectors, nylon insulated, with current carrying parts of copper alloy, for conductors #16 AWG and smaller.
- .2 Fork tongue, nylon insulated, crimp style terminals for connecting conductors #16 AWG and smaller to screw down terminals.
- .3 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper alloy sized to fit copper conductors. Use twist-on connectors for #14 AWG to #8 AWG wires.
- .4 Crimp style wire connectors, nylon insulated with current carrying parts of copper alloy, for connecting solid to stranded conductors.
- .5 Compression type connectors for connecting #6 AWG conductors and larger. Compression type connectors to have a temperature rating of 90 deg. C.
- .6 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper alloy sized to fit copper conductors 10 AWG or less.
- .7 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1 Connector body and stud clamp for stranded round copper conductors.
  - .2 Clamp for stranded round copper conductors.
  - .3 Stud clamp bolts.
  - .4 Bolts for copper conductors.
  - .5 Sized for conductors as indicated.
- .8 Clamps or connectors for TECK cable to: CAN/CSA-C22.2 No.18.3.

Part 3 Execution

3.1 INSTALLATION

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

3.2 RESTRICTIONS

- .1 No splices are allowed in panelboards (distribution, lighting and power) or in equipment enclosures.

END OF SECTION



Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 20 – Wire and Box Connectors (0-1000 V).
- .3 Section 26 05 29 – Hangers and Supports for Electrical Systems.
- .4 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .5 Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts.
- .6 Section 33 65 73 – Concrete Encased Duct Banks.
- .7 Section 33 65 76 – Direct Buried Underground Cable Ducts.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 C22.2 No.0.3-09 (R2014), Test Methods for Electrical Wires and Cables.
  - .2 C22.2 No. 131-14, Type TECK 90 Cable.
- .2 National Research Council of Canada
  - .1 National Building Code of Canada (NBCC) 2015.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors:
  - .1 Solid for 10 AWG and smaller, stranded for 8 AWG and larger.
  - .2 Minimum size: 12 AWG for branch circuits, 12 AWG for bonding, 14 AWG for control circuits.
- .2 Copper conductors: with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE and RWU90 XLPE, non-jacketed.
- .3 Single conductor metal sheathed cables are not permitted.
- .4 All underground wiring whether installed in conduit or not shall be rated RWU.

2.2 TECK 90 CABLE

- .1 Cable: to CAN/CSA C22.2 No. 131-M89 (R1994), Type TECK 90 Cable.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper.
- .3 Insulation:
  - .1 Cross-linked polyethylene XLPE.
  - .2 Rating: 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride, FT4 rated.
- .7 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 1500 mm centers.
  - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
  - .1 Watertight, approved for TECK cable.

2.3 CONTROL CABLES

- .1 Type: LVT: soft annealed copper conductors:
  - .1 Insulation: thermoplastic.
  - .2 Sheath: thermoplastic jacket, FT4 rated.

2.4 COLOUR CODING

- .1 All conductors to be colour coded to Section 26 05 00 – Common Work Results for Electrical.

Part 3 Execution

3.1 WIRING METHODS

- .1 All work to be concealed in finished areas.
- .2 Service: building wire in conduit, copper conductors.
- .3 Panel feeders:
  - .1 Building wire in conduit.

- .4 Branch circuit work:
  - .1 Concealed work in wall partitions: building wire in conduit.
  - .2 Horizontal work above accessible ceilings: building wire in conduit.
  - .3 Surface work in unfinished areas: building wire in conduit.

### 3.2 GENERAL CABLE INSTALLATION

- .1 Cable routing where indicated is in diagrammatic form only. Review existing conditions and all tender drawings when planning routing. Implement all required offsets to coordinate with site conditions, equipment and other trades. Adjust cable routing on site as required. Include all costs in tender submission for cable routing.
- .2 Install cables in trenches and in ducts in accordance with Section 26 05 43.01 – Installation of Cables in Trenches and in Ducts.
- .3 Support cables in accordance with Section 26 05 29 – Hangers and Supports for Electrical Systems.
- .4 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors – (0-1000 V).
- .5 Cable Colour Coding: to Section 26 05 00 – Common Work Results for Electrical.
- .6 Conductor length for parallel feeders to be identical.
- .7 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

### 3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
  - .2 In underground ducts in accordance with Section 33 65 73 – Concrete Encased Duct Banks.
  - .3 In underground direct buried conduits in accordance with Section 33 65 76 – Direct Buried Underground Cable Ducts.

### 3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by straps.
- .3 Fasten in place at 1500 mm intervals and 300 mm from terminations.

3.5 INSTALLATION OF CONTROL CABLES

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

3.6 RESTRICTIONS

- .1 Splices in wire and cable #6 AWG and larger are not permitted.
- .2 Wiring and cabling shall not pass through or penetrate into exit stairwells except to provide services for the stairwell. Wiring and cabling serving stairwells must be totally enclosed in non-combustible raceway, in accordance with NBCC requirements.
- .3 Wiring and cabling must be run parallel and perpendicular to building lines. Wherever possible, wiring and cabling is to follow a common pathway.
- .4 Wires and cables installed within plenum spaces in buildings of non-combustible construction to have FT6 rated jackets in accordance with the NBCC unless installed in conduit.
- .5 All wiring for services within the building must be installed on the warm side of the vapour barrier unless prior approval is obtained from the Departmental Representative to run on the cold side.
- .6 Refer to Section 26 05 29 – Hangers and Supports for Electrical Systems, for acceptable support methods.
- .7 Do not install cables, raceways and boxes directly to underside of roof decking. Support cables, raceways and boxes so that their nearest outside surface is not less than 38 mm from bottom of roof decking.

3.7 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.

END OF SECTION

Part 1            General

1.1            RELATED SECTIONS

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

1.2            REFERENCE STANDARDS

- .1            American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1            ANSI/IEEE 837-2014, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2            Canadian Standards Association (CSA International)
  - .1            C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard with NMX-J-590-ANCE and UL 467).
- .3            NS Power
  - .1            Standard Construction Practices.

1.3            CLOSEOUT SUBMITTALS

- .1            Submit in accordance with Division 01 – General Requirements.
- .2            Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.4            DELIVERY, STORAGE AND HANDLING

- .1            Deliver, store and handle materials in accordance with Division 01 – General Requirements and with manufacturer's written instructions.
- .2            Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3            Storage and Handling Requirements:
  - .1            Store materials off ground indoors in clean, dry location and in accordance with manufacturer's recommendations.
  - .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: to electrically conductive underground water pipe.
- .2 Plate electrodes: hot-dipped galvanized steel, surface area 0.1 m<sup>2</sup>, minimum 6.35 mm thick, with connector.
- .3 Grounding conductors: bare stranded copper, soft annealed.
- .4 Insulated grounding conductors: green, Type RW90, copper conductors, in accordance with Section 26 05 21 – Wires and Cables (0-1000 V).
- .5 Non-corroding accessories necessary for grounding system, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Electric power utility equipment including bollards if applicable, must be grounded in accordance with utility Standard Construction Practices.
- .2 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .3 All grounding connectors, components and accessories to be installed in accordance with manufacturer's instructions.
- .4 Install green insulated bonding conductor in all conduit.
- .5 Protect exposed grounding conductors from mechanical injury.
- .6 Make buried connections to electrodes, using copper welding by thermit process, permanent mechanical connectors, or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .7 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .8 Soldered joints not permitted.

- .9 Install an integral bonding wire in all flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

### 3.2 ELECTRODES

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2 Install water meter shunt.
- .3 Install plate electrodes and make grounding connections.
- .4 Bond separate, multiple electrodes together.
- .5 Use size #6 AWG copper conductors for connections to electrodes.
- .6 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails.

### 3.3 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary 600 V and 240/208 V systems.

### 3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to the following list: service equipment, transformers, switchgear.

### 3.5 FIELD QUALITY CONTROL

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

### 3.6 RESTRICTIONS

- .1 Insulated grounding conductors within ceiling air plenums must be installed in conduit.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCE STANDARDS

- .1 ASTM International Inc.
  - .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Products.
  - .3 ASTM A240/A240M-17, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .4 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
  - .5 ASTM B633-15, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- .2 Canadian Standards Association (CSA International)
  - .1 C22.2 No. 18.4-15, Hardware for the Support of Conduit, Tubing and Cable (Bi-National Standard with UL 2239).

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.
- .2 Material and finish: hot-dipped galvanized steel to ASTM A123.

2.2 BRACKETS, POST BASES & FITTINGS

- .1 Specific purpose support channel accessories including brackets, post bases & fittings for channel assembly.
- .2 Material and finish: hot-dipped galvanized steel to ASTM A123.

2.3 SPECIFIC PURPOSE FASTENERS

- .1 Specific purpose heat treated, spring fasteners to support boxes, conduit and cable from main structure, channels, metal studs and T-bar ceilings.



- .2 Material and finish:
  - .1 Channel nuts and spring nuts: steel, electro-plated zinc to ASTM B633 SC1 Type III.
  - .2 Strut clamps, conduit straps, beam clamps, specific purpose fasteners, etc.: hot-dipped galvanized steel to ASTM A153.
- 2.4 HARDWARE AND FASTENERS
  - .1 Bolts, nuts, washers and threaded rod.
  - .2 Material and finish:
    - .1 Hot-dipped galvanized steel to ASTM A153.
- Part 3 Execution
  - 3.1 GENERAL
    - .1 Hangers and supports including support channels, brackets, post bases, fittings, specific purpose fasteners, hardware and fasteners to be of material and finish suitable for their use as follows:
      - .1 Indoor use in dry locations: pre-galvanized steel.
      - .2 Outdoor use or where exposed to wet environments: hot-dipped galvanized steel.
  - 3.2 INSTALLATION
    - .1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with nylon shields.
    - .2 Secure equipment to poured concrete with expandable inserts.
    - .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
    - .4 Secure recessed and surface mounted equipment to inverted T bar ceilings with bar type box hangers fastened to grid. Ensure that T-bars and box hangers are adequately supported to carry weight of equipment specified before installation. Box hangers to be connected to building structure with independent hanger wire.
    - .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 dia threaded rods and spring clips.
  - .2      Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical. Provide sufficient quantity of rod hangers to support total weight of cables or conduits as well to ensure support channels remain horizontal and level.
- .8      For surface mounting of two or more conduits use channels at 1500 mm on centre spacing.
- .9      Provide metal brackets, frames, hangers, clamps and related types of support structures to support conduit and cable runs.
- .10     Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11     Install fastenings and supports for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

### 3.3      RESTRICTIONS

- .1      Do not use wire lashing, perforated strap, nylon or plastic self locking cable ties (Ty-raps) to support or secure raceways or cables.
- .2      Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .3      Do not use T-bar ceiling hanger wires to support conduit and cable.
- .4      Do not install cables, raceways and boxes directly to underside of roof decking. Support cables, raceways and boxes so that their nearest outside surface is not less than 38 mm from bottom of roof decking.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 C22.1-18, Canadian Electrical Code (CEC), Part 1, 24<sup>th</sup> Edition.
  - .2 C22.2 No. 40-M1989 (R2014), Cutout, Junction and Pull Boxes.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure, flush or surface mounted.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

2.2 FINISHES

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

Part 3 Execution

3.1 JUNCTION AND PULL BOXES INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Install junction and pull boxes in accordance with CSA C22.1. Provide pull boxes so as not to exceed 30 m of conduit run between pull boxes.
- .3 Size and install junction and pull boxes to 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 phases.

3.3 RESTRICTIONS

- .1 Pull boxes to be installed in-line with conduit runs. Pull boxes must not be used in lieu of conduit elbows.
- .2 Do not install junction and pull boxes directly to underside of roof decking. Support junction and pull boxes so that their nearest outside surface is not less than 38 mm from bottom of roof decking.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 C22.1-18, Canadian Electrical Code (CEC), Part 1, 24<sup>th</sup> Edition.
  - .2 C22.2 No.18.1-13, Metallic Outlet Boxes (Tri-National Standard with UL 514A and ANCE NMX-J-023/1).
- .2 National Research Council of Canada
  - .1 National Building Code of Canada (NBCC) 2015.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

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

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 51 x 51 mm. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.
- .5 Round type plaster rings to be used in plaster construction only.

2.3 CONDUIT BOXES

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

2.4 FITTINGS - GENERAL

- .1 Set-screw type steel couplings and connectors for EMT. Connectors to have integral, factory installed, nylon insulated throats.
- .2 Bushings and connectors with nylon insulated throats.
- .3 Knock-out fillers to prevent entry of debris.
- .4 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .5 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Outlet boxes and conduit boxes to be flush mounted in new construction. Outlet and conduit boxes in existing construction to be flush mounted except in existing masonry filled block walls or existing concrete walls where flush mounting is impossible.
- .3 The use of surface mounted conduit boxes is to be minimized, limited to unfinished areas and is subject to the approval of the Departmental Representative.
- .4 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .5 Provide correct size of openings in boxes for conduit connections. Do not install reducing washers.
- .6 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .7 Identify systems for outlet boxes.

3.2 RESTRICTIONS

- .1 The use of surface type device boxes in finished areas is not permitted.
- .2 Do not install outlet boxes, conduit boxes and fittings directly to underside of roof decking. Support outlet boxes, conduit boxes and fittings so that their nearest outside surface is not less than 38 mm from bottom of roof decking.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 29 – Hangers and Supports for Electrical Systems.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 C22.2 No. 18.3-12, Conduit, Tubing, and Cable Fittings (Tri-National Standard with ANCE NMX-J-017 and UL 514B).
  - .2 C22.2 No. 18.4-15, Hardware for the Support of Conduit, Tubing and Cable (Bi-National Standard with UL 2239).
  - .3 C22.2 No. 83-M1985 (R2013), Electrical Metallic Tubing.
  - .4 C22.2 No. 211.2-06 (R2011), Rigid PVC (Unplasticized) Conduit.

1.3 LOCATION OF CONDUITS

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

1.4 CONDUIT SIZE

- .1 Conduit sizing is based on copper conductors and EMT conduit. Where conduit type requires an additional bond wire, adjust conduit size to suit.

Part 2 Products

2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with steel set-screw couplings and connectors where conduit is routed above sprinkler pipes; with watertight compression couplings and connectors where conduit is routed below sprinkler pipes and for vertical exposed surface mounted portion of run.
- .2 Rigid PVC conduit: to CSA C22.2 No. 211.2.

2.2 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure surface conduits 50 mm and smaller.
  - .1 Two-hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1500 mm on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18.3, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Set-screw type steel couplings and connectors for EMT only to be used where conduit is routed above sprinkler pipes. Connectors to have integral, factory installed, nylon insulated throats.
- .3 Watertight compression couplings and connectors for EMT when conduit is routed below sprinkler pipes or for vertical exposed surface mounted portion of run.
- .4 Use factory "ells" where 90 degrees bends for 27 mm and larger conduits.

2.4 FISH CORD

- .1 Polypropylene.

2.5 SEALANT

- .1 Low VOC mastic compound.

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 All wiring and conduit are shown in diagrammatic form only.
- .2 Be familiar with building ceiling spaces. Most conduit runs shown as straight runs will consist of several offsets due to site conditions, equipment and services. Alternate paths to achieve similar runs may be proposed after detailed review of site conditions. Include all costs for alternate routes to suit conduit runs.
- .3 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .4 Install conduit parallel or perpendicular to building lines.
- .5 Conceal horizontal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .6 All horizontal conduit work is to be in ceiling space.



- .7 Conceal all conduit drops to devices within walls for new construction. Conduit drops to surface mounted devices will only be permitted in the case of existing masonry filled block walls or existing concrete walls where flush mounting is impossible.
- .8 Use EMT conduit for all exposed service work, where subject to mechanical damage and as required by CEC.
- .9 Use electrical metallic tubing (EMT) for feeders and branch circuit work except in poured concrete, underground and where subject to mechanical damage. Install a separate integral bond wire sized in accordance with CEC in all EMT.
- .10 Use rigid PVC conduit for feeders and branch circuit work underground, under ground floor slab and in poured concrete. Where the use of underground duct is indicated, use duct to rigid PVC conduit transition for conduit extending above finished grade. Apply cleaning and solvent compounds to manufacturer's recommendations and make joints watertight. Install a separate integral bond wire sized in accordance with CEC in all rigid PVC conduit. Restrictions for use:
  - .1 Do not use in hazardous locations.
  - .2 Do not use where enclosed in thermal insulation.
  - .3 Do not use where exposed.
  - .4 Do not exceed 270 degrees in conduit bends per conduit run for below slab conduit (i.e. three 90 degree bends maximum).
  - .5 Must contain an integral bond wire sized in accordance with CEC.
  - .6 Feeds from building exterior must make transition to EMT upon entering building.
- .11 Minimum conduit size for lighting and power circuits: 21 mm.
- .12 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .13 Mechanically bend steel conduit over 21 mm diameter.
- .14 Install fish cord in empty conduits.
- .15 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .16 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/surface channels.

- .5 Do not pass conduits through structural members.
- .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 Group conduits wherever possible on suspended/surface channels.
- .3 Do not pass conduits through structural members.
- .4 Do not install horizontal runs in walls.
- .5 Do not install conduits in concrete slab or under slabs at grade level.

### 3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Organize conduits in slab to minimize cross-overs.

### 3.6 CONDUITS UNDERGROUND

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

### 3.7 CONDUIT SEALANT

- .1 All conduits entering buildings from underground or penetrating the building vapour barrier must be internally sealed immediately inside the building after installation of wires to prevent the entrance of water and condensation.
- .2 Seal conduit using mastic compound.
- .3 Install in accordance with manufacturer's instructions.

### 3.8 VAPOUR BARRIER PENETRATIONS

- .1 Conduit and wire penetrations of vapour barriers must be effectively sealed to maintain the integrity of the vapour barrier.

3.9 RESTRICTIONS

- .1 Conduit and wiring shall not pass through or penetrate into exit stairwells except to provide services for the stairwell, in accordance with NBCC requirements.
- .2 Exposed surface mounted conduit in finished areas is not permitted.
- .3 Do not install raceways and boxes directly to underside of roof decking. Support raceways and boxes so that their nearest outside surface is not less than 38 mm from bottom of roof decking.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .3 Section 33 65 73 – Concrete Encased Duct Banks.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association, (CSA International)
- .2 Insulated Cable Engineers Association, Inc. (ICEA)

Part 2 Products

2.1 CABLE PULLING EQUIPMENT

- .1 6 mm stranded nylon/polyester pull rope tensile strength 5 kN.

2.2 WARNING TAPE

- .1 Metal-detectable warning tape, 76 mm wide, 5 mils thick, red polyester material laminated to aluminum foil core, imprinted with black letters indicating "CAUTION BURIED ELECTRIC LINE BELOW".

2.3 DUCT END SEAL

- .1 Low VOC mastic compound.

Part 3 Execution

3.1 EXAMINATION

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

### 3.2 CABLE INSTALLATION IN DUCTS

- .1 Install cables in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 Before pulling cable into ducts and until cables are properly terminated, seal ends of cables with moisture seal tape.
- .6 After installation of cables, seal duct ends with duct sealing compound.
- .7 Install in each empty duct a pull rope continuous throughout each duct run with 3 m spare rope at each end.

### 3.3 WARNING TAPE

- .1 Install warning tape 300 mm below final grade, continuous over full length of cable ducts.

### 3.4 DUCT SEALANT

- .1 All ducts entering buildings from underground or penetrating the building vapour barrier must be internally sealed immediately inside the building after installation of wires to prevent entrance of water and condensation.
- .2 Install in accordance with manufacturer's instructions.

### 3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Perform tests using qualified personnel.
  - .1 Include necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds.
- .5 Tests:
  - .1 After installing cable but before terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
  - .2 Ensure resistance to ground of circuits is not less than 50 megohms.
- .6 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.

- .7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

### 3.6 PROTECTION

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

END OF SECTION

- Part 1            General
- 1.1            RELATED SECTIONS
- .1            Section 26 05 00 – Common Work Results for Electrical.
- 1.2            REFERENCE STANDARDS
- .1            Canadian Standards Association (CSA International)
- .1            C9-17, Dry-Type Transformers.
- .2            C22.2 No.47-13 (R2018), Air-Cooled Transformers (Dry Type).
- .3            CAN/CSA-C802.2-12, Minimum Efficiency Values for Dry Type Transformers.
- .4            CAN/CSA-C802.2-18, Test Method and Minimum Efficiency Values for Dry Type Transformers.
- .2            National Electrical Manufacturers Association (NEMA)
- 1.3            ACTION AND INFORMATIONAL SUBMITTALS
- .1            Submit in accordance with Division 01 – General Requirements.
- .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.
- .2            Include published data indicating load and no-load efficiencies and losses in conformance with CAN/CSA C802.2.
- 1.4            CLOSEOUT SUBMITTALS
- .1            Submit in accordance with Division 01 – General Requirements.
- .2            Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.
- 1.5            DELIVERY, STORAGE AND HANDLING
- .1            Deliver, store and handle materials in accordance with Division 01 – General Requirements and with manufacturer's written instructions.
- .2            Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3            Storage and Handling Requirements:
- .1            Store materials off ground indoors in clean, dry, well-ventilated location and in accordance with manufacturer's recommendations.
- .2            Store and protect dry type transformers from nicks, scratches, and blemishes.
- .3            Replace defective or damaged materials with new.

Part 2 Products

2.1 TRANSFORMERS

- .1 Transformers to be in accordance with CSA C9 and CAN/CSA C22.2 No.47.
- .2 Load and no-load efficiencies and losses to be in accordance with CAN/CSA C802.2 and NRCan 2019. No load and full load losses to exceed those indicated in NRCan 2019.
- .3 Use transformers from one manufacturer throughout project.
- .4 Transformer design to meet equipment space allowance indicated on drawings.
- .5 Design 1 – K-factor Distribution Transformers.
  - .1 Type: ANN.
  - .2 Single phase, 3 winding, kVA as indicated on drawings, 600 V input, 120/240 V output, 60 Hz.
  - .3 Voltage taps: standard.
  - .4 Insulation: Class 220 with epoxy impregnation insulation system per UL-1446, 150 degrees C temperature rise.
  - .5 Basic Impulse Level (BIL): standard.
  - .6 Hipot: standard.
  - .7 Average sound level: standard.
  - .8 Impedance at 170 degrees C: standard.
  - .9 Enclosure: air ventilated, CSA 3R sprinklerproof, removable metal front panel.
  - .10 Anti-vibration pads to be provided between the core and the enclosure.
  - .11 Mounting: floor.
  - .12 Copper windings.
  - .13 Oversized neutral.
  - .14 Electrostatic shield.
  - .15 K-factor of 13 for non-linear loads.
  - .16 Voltage Regulation to be 4% or better.
  - .17 Maximum dimensions to fit in existing floor space: 825.5mm W x 901.7mm D. Existing height is 1136.7mm.

2.2 EQUIPMENT IDENTIFICATION

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

2.3 FINISHES

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



Part 3 Execution

3.1 INSTALLATION

- .1 Floor mount dry type transformers.
- .2 Ensure adequate clearance around transformer for ventilation.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.
- .5 Loosen isolation pad bolts until no compression is visible.
- .6 Make conduit entry into bottom 1/3 of transformer enclosure using flexible conduit.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Three single-phase transformers to be wired to existing special distribution panel with 7 buses for 120/240 V single-phase and 120/208 V three-phase distribution.
- .9 Energize transformers after installation is complete.

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 SECTIONS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 28 – Grounding – Secondary.
- .3 Section 26 05 31 – Junction and Pull Boxes.
- .4 Section 26 24 02 – Service Entrance Board.
- .5 Section 26 28 16.02 – Molded Case Circuit Breakers.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 – General Requirements.
- .2 Product Data: submit manufacturer's instructions, printed product literature, and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 SUPPLY DATA

- .1 Power supply: 600V, 800A, 60 Hz, 3 phase, 4 wire grounded neutral.

Part 2 Products

2.1 EQUIPMENT

- .1 Service Entrance Board: in accordance with Section 26 24 02 – Service Entrance Board.

2.2 FINISHES

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

Part 3 Execution

3.1 INSTALLATION

- .1 Install service equipment.
- .2 Connect to incoming service.
- .3 Connect to outgoing load circuits.
- .4 Make grounding connections in accordance with Section 26 05 28 – Grounding – Secondary and Utility requirements.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 C22.2 No.31-14, Switchgear Assemblies.
  - .2 CAN3-C17-M84 (R2015), Alternating-Current Electricity Metering.
  - .3 CAN/CSA C61869-1:14, Instrument Transformers – Part 1: General Requirements.
  - .4 CAN/CSA C61869-2:14, Instrument Transformers – Part 2: Additional Requirements for Current Transformers.

1.3 DESCRIPTION

- .1 Holland Building:
  - .1 Install a new 800A, 347/600V, 3 phase, 4 wire service entrance board in the new electrical room and feed underground from padmount transformer. Feed the existing/retrofit service entrance board from the new service entrance board.
  - .2 There is an existing Square D, 1000A, 347/600V, 3 phase, 4 wire service entrance board located in the electrical room. The board incorporates service entrance main breaker, analog and digital metering, metering transformer compartment and distribution section, factory assembled in a vertical two section enclosure. Retrofit existing service entrance board with new main breaker, TVSS, digital metering, provision for additional future digital metering and distribution circuit breakers as indicated on drawing. Distribution section to be ready for future breakers the full height of the section. Modifications and alterations to the service entrance board to be completed by the original equipment manufacturer. The service entrance board to be re-certified by CSA or equivalent certification agency approved in the Province of Nova Scotia after the modifications are completed.
  - .3 Disconnect and remove existing incoming service feeder and reconnect to new incoming service feeder. Note that the new service feeder will enter through the top of the board and the existing main breaker is installed in the bottom of the board. Make provisions to route the feeder to the new main breaker location.
  - .4 Disconnect and reconnect outgoing distribution feeders to new breakers.
  - .5 Existing service grounding connections to remain. Disconnect neutral grounding.
  - .6 Provide temporary work to maintain power to buildings during normal working hours.
  - .7 Power interruptions are to be done and restored outside normal working hours  
Normal working hours are Monday to Friday, 6:00am to 6:00pm.

.2 Murray Building:

- .1 There is an existing Square D, 1000A, 347/600V, 3 phase, 4 wire service entrance board located in the electrical room. The board incorporates service entrance main breaker, metering transformer compartment and distribution section, factory assembled in a vertical two section enclosure. Retrofit existing service entrance board with new main breaker, TVSS, digital metering, provision for additional future digital metering and distribution circuit breakers as indicated on drawing. Distribution section to be ready for future breakers the full height of the section. Modifications and alterations to the service entrance board to be completed by the original equipment manufacturer. The service entrance board to be re-certified by CSA or equivalent certification agency after the modifications are completed.
- .2 Disconnect and reconnect existing incoming service feeder and outgoing distribution feeders to new breakers.
- .3 Existing service grounding connections to remain.
- .4 Provide temporary work to maintain power to buildings during normal working hours.
- .5 Power interruptions are to be done and restored outside normal working hours. Normal working hours are Monday to Friday, 6:00am to 6:00pm.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01 – General Requirements.
- .2 Product Data: submit manufacturer's instructions, printed product literature and data sheets for service entrance board and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit detailed drawings generated by manufacturer.
  - .2 Indicate on drawings:
    - .1 Dimensioned cable entry and exit locations.
    - .2 Dimensioned position and size of bus.
    - .3 Overall length, height and depth.
    - .4 Dimensioned layout of internal and front panel mounted components.
    - .5 Single line diagram.
- .4 Include time-current characteristic curves for circuit breakers rated 300 A and higher.

1.5 QUALITY ASSURANCE

- .1 Submit copies of certified test results.

1.6 SYSTEM STARTUP AND TRAINING

- .1 System startup and training is to be conducted by manufacturer's authorized factory trained service technician.

- .2 Arrange and provide on-site lectures and demonstrations at time convenient to Departmental Representative's personnel.
- .3 Explain and demonstrate operation of Departmental Representative's meter including advanced monitoring functions.

#### 1.7 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for service entrance board for incorporation into manual specified in Division 01 – General Requirements.
- .2 Submit maintenance data for complete assembly including components.

#### 1.8 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Division 01 – General Requirements.
- .2 Provide one (1) set of spare parts as recommended by manufacturer.

#### 1.9 SUPPLY DATA

- .1 Power supply: 600V, 3 phase, 4 wire, grounded neutral, 60 Hz, short circuit current 65 kA rms symmetrical.

#### 1.10 DESCRIPTION OF EQUIPMENT

- .1 Service entrance board incorporates service entrance main breaker, digital metering compartments and distribution section, factory assembled in a sprinklerproof, vertical two section enclosure.

### Part 2 Products

#### 2.1 HOLLAND BUILDING

- .1 New Service Entrance Board:
  - .1 To CAN/CSA C22.2 No.31.
  - .2 Rating: 600 V, 800 A, 3 phase, 4 wire, short circuit current 65 kA (rms symmetrical).
  - .3 One section consisting of main breaker, TVSS, Departmental Representative's metering compartment distribution section and outgoing lugs.
  - .4 Cubicle: free standing, dead front, CSA 3R sprinklerproof, size as indicated.
  - .5 Barrier metering section from adjoining sections.
  - .6 Departmental Representative's metering.
  - .7 Integrated surge suppression.
  - .8 Distribution section.
  - .9 Access panels with captive knurled thumb screws.
  - .10 Bus bars and main connections: 99.3% copper.

- .11 Bottom entry with lugs suitable for service cabling.
- .12 Top exit with lugs suitable for 800 A feeder cabling.
- .13 Bus from load terminals of main breaker via metering section to main lugs of distribution section.
- .14 Identify phases with colour coding.
- .15 When a 100% rated main breaker is used, the service entrance board is to have factory installed labelling stating that the entire assembly is rated for 100% continuous duty.
- .16 Maximum dimensions: 914 mm W x 610 mm D x 2324 mm H.
- .17 Bottom conduit entry opening: 229 mm W x 210 mm D, centred.
- .2 Solid State Trip Breakers (Main Breaker and As Indicated):
  - .1 Molded case circuit breakers to be in accordance with Section 26 28 16.02 – Molded Case Circuit Breakers.
  - .2 Molded case circuit breakers to operate by means of a solid-state trip unit with associated RMS current monitors and self-powered shunt trip to provide inverse time current trip under overload condition with field adjustable settings for long time, short time and instantaneous tripping for phase and ground fault short circuit protection. Note that long time, short time and instantaneous settings must be **individually** adjustable.
  - .3 Circuit breakers to have interchangeable trip units.
  - .4 Breaker interrupting capacity to match service entrance board.
  - .5 Main breaker:
    - .1 800 A frame, 100% rated, with 100% continuous current rating plug of 800 A, LSI.
  - .6 Distribution breakers:
    - .1 Space for one 250A, 100% rated, with 100% continuous current rating plug as indicated, LSI.
  - .7 Provide solid state trip breakers in distribution sections as indicated.
- .3 Surge Suppression:
  - .1 Service entrance board to be complete with built-in surge suppression.
  - .2 All materials to be CSA approved.
  - .3 Parallel across the line module design, staged transient voltage surge suppression circuitry.
  - .4 Diagnostic LED in each module indicating module is active and functioning properly.
  - .5 IEEE C62.41.1-2002 Category A, B and C suppression response.
  - .6 UL Standard 1449 Third Edition Revised Standard for Surge Protective Devices.
  - .7 All mode protection per IEEE Standard 1100-2005, line to neutral, line to line, line to ground and neutral to ground.
  - .8 Maximum rated surge current: 240 kA per phase, 120 kA per mode.
  - .9 Thermodynamic fuse protection with individual fused MOV's.
  - .10 UL 1283 EMI/RFI Noise filter attenuation: up to 50 dB from 10 kHz to 100 MHz.

- .11 Rated for: 347/600 V, AC, 3 phase, WYE, 4 wire plus ground as indicated.
- .12 Direct bus bar connection.
- .4 Grounding:
  - .1 Copper ground bus extending full width of cubicles and located at bottom.
  - .2 Lugs for size #6 to 3/0 AWG grounding cable, quantity as indicated.
  - .3 Bond non-current carrying metal parts to ground bus.
  - .4 Removable bus link between ground and neutral bus bars.
- .5 Departmental Representative's Metering
  - .1 Provide space for future digital meter:
    - .1 375 mm H metering compartment.
    - .2 Bi-directional energy meter for feed-in management and energy consumption monitoring.
    - .3 Manufacturer: Fronius Smart Meter c/w current transformers.

## 2.2 RETROFIT IN HOLLAND AND MURRAY BUILDINGS

- .1 Retrofitted Service Entrance Board:
  - .1 To CAN/CSA C22.2 No.31.
  - .2 Rating: 600 V, 1000 A, 3 phase, 4 wire, short circuit current 50 kA (rms symmetrical).
  - .3 Two sections consisting of main breaker section, digital metering compartment section and distribution section.
  - .4 Cubicles: free standing, dead front, CSA 3R sprinklerproof, size as indicated.
  - .5 Barrier metering section from adjoining sections.
  - .6 Departmental Representative's metering.
  - .7 Integrated surge suppression.
  - .8 Distribution section.
  - .9 Access panels with captive knurled thumb screws.
  - .10 Bus bars and main connections: 99.3% copper.
  - .11 Bus from load terminals of main breaker via metering section to main lugs of distribution section.
  - .12 Identify phases with colour coding.
- .2 Solid State Trip Breakers (Main Breaker and As Indicated):
  - .1 Molded case circuit breakers to be in accordance with Section 26 28 16.02 – Molded Case Circuit Breakers.
  - .2 Molded case circuit breakers to operate by means of a solid-state trip unit with associated RMS current monitors and self-powered shunt trip to provide inverse time current trip under overload condition with field adjustable settings for long time, short time and instantaneous tripping for phase and ground fault short circuit protection. Note that long time, short time and instantaneous settings must be **individually** adjustable.
  - .3 Circuit breakers to have interchangeable trip units.

- .4 Breaker interrupting capacity to match service entrance board.
- .5 Main breaker:
  - .1 1000 A frame, 100% rated, with 100% continuous current rating plug of 1000 A, LSIG.
- .6 Distribution breakers:
  - .1 Breakers over 200 A to be 100% rated, solid state LSI.
  - .2 Amperage as indicated, 80% rated, with 80% continuous current rating plug as indicated.
- .7 Provide solid state trip breakers in distribution sections as indicated.
- .8 Distribution sections to have double row distribution, capable of handling up to 250 A, 3 pole breakers mounted opposite each other on the same horizontal row.
- .3 Surge Suppression:
  - .1 Service entrance board to be complete with built-in surge suppression.
  - .2 All materials to be CSA approved.
  - .3 Parallel across the line module design, staged transient voltage surge suppression circuitry.
  - .4 Diagnostic LED in each module indicating module is active and functioning properly.
  - .5 IEEE C62.41.1-2002 Category A, B and C suppression response.
  - .6 UL Standard 1449 Third Edition Revised Standard for Surge Protective Devices.
  - .7 All mode protection per IEEE Standard 1100-2005, line to neutral, line to line, line to ground and neutral to ground.
  - .8 Maximum rated surge current: 240 kA per phase, 120 kA per mode.
  - .9 Thermodynamic fuse protection with individual fused MOV's.
  - .10 UL 1283 EMI/RFI Noise filter attenuation: up to 50 dB from 10 kHz to 100 MHz.
  - .11 Rated for: 347/600 V, AC, 3 phase, WYE, 4 wire plus ground as indicated.
  - .12 Direct bus bar connection.
- .4 Grounding:
  - .1 Copper ground bus extending full width of cubicles and located at bottom.
  - .2 Lugs for size #6 to 3/0 AWG grounding cable, quantity as indicated.
  - .3 Bond non-current carrying metal parts to ground bus.
  - .4 Removable bus link between ground and neutral bus bars.
- .5 Departmental Representative's Metering:
  - .1 Digital metering system, CSA approved:
    - .1 Microprocessor based metering package measuring RMS values.
    - .2 Displays voltage and current for each phase, kW, kVAR, kVA, PF, Hz and accumulated kWH and kW demand.
    - .3 Monitors and stores in non-volatile memory minimum values of amps, kW, kVAR, kVA and kW demand. All values can be called up and displayed.



- .4 Monitors individual harmonics through the 31st for volts and amps.
- .5 Field programmable.
- .6 RS-485 and Ethernet RJ-45 communications ports.
- .7 4-20mA output for connection to a remote monitoring system to monitor kW demand and kWH consumption.
- .8 Relay output contacts programmable to act as a kWH, kVARH or kVAH pulse initiator output.
- .9 Power supply:
  - .1 120 V AC, 15 VA.
- .10 Operating environment:
  - .1 Temperature: -10 degrees C to 50 degrees C.
  - .2 Storage temperature: -40 degrees C to 85 degrees C.
  - .3 Humidity: 5 – 95% RH at 40 degrees C.
- .11 Acceptable manufacturer for the Digital Meter:
  - .1 Schneider Electric PM-8244 c/w TCP IP Ethernet Card, Reliable Controls MACH-Pro BACnet controller.  
Restriction of existing assembly: to ensure the compatibility and consistency between new digital meter and existing digital meter, the new digital meter shall be compatible with existing ION metering network installed at the Bedford Institute of Oceanography.
- .2 Current transformers: to CAN/CSA C60044-1, dry type, epoxy moulded, for indoor use with the following characteristics:
  - .1 Nominal voltage class: 600 V.
  - .2 Rated frequency: 60 Hz.
  - .3 Basic impulse level: 10 kV.
  - .4 Metering accuracy rating: 0.3.
  - .5 Rated primary and secondary current: as indicated.
  - .6 Continuous current rating factor: 1.5.
  - .7 Short-time mechanical current rating 90 times primary rating.
  - .8 Short-time thermal current.
  - .9 Positive action automatic short-circuiting device in the secondary terminals.
- .3 Future Digital Meter:
  - .1 Bi-directional energy meter for feed-in management and energy consumption monitoring.
  - .2 Manufacturer: Fronius Smart Meter c/w current transformers.

## 2.3 COVERS

- .1 New covers as required to enclosure new equipment and breakers in existing service board.

2.4 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 – Common Work Results for Electrical.
  - .1 Provide two spray cans of touch-up enamel.

2.5 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Nameplates:
  - .1 White plate, black letters, size 7.
  - .2 Complete board labelled: "SEB – 800 A, 600 V, 3 phase, 4W, 65 kAIC".
  - .3 Main breaker labelled: "100% Rated Main Breaker".
  - .4 Branch breakers labelled to indicate connected load.

2.6 MANUFACTURERS

- .1 Acceptable manufacturer:
  - .1 Schneider Electric.  
Restriction of existing assembly: The existing switchboards currently installed at the Holland Building and Murray Building are from Schneider Electric "Square D".

Part 3 Execution

3.1 INSTALLATION

- .1 Holland Building:
  - .1 Install new 600A temporary breaker in Murray Building distribution and feed new temporary panel in Holland Building.
  - .2 Provide temporary circuit extensions from distribution breaker feeders to temporary panel.
  - .3 Arrange and pay for all associated cost for Nova Scotia Power to de-energize the service to the building. De-energize the service entrance board and disconnect main secondary from line terminals of main breaker.
  - .4 New service entrance board:
    - .1 Install service entrance board.
    - .2 Connect main secondary service to line terminals of main breaker.
    - .3 Connect load terminals of outgoing lugs to feeder to retrofit service entrance board.
    - .4 Check factory made connections for mechanical security and electrical continuity.
    - .5 Connect ground bus to service ground.

- .6 Run one grounding conductor #6 AWG bare copper in 27 mm conduit from ground bus to water entrance and one grounding conductor to ground plates.
- .7 Adjust breaker trip unit settings as per the coordination study.
- .5 Retrofit service entrance board:
  - .1 Replace existing main breaker with new.
  - .2 Replace existing distribution circuit breakers with new as indicated.
  - .3 Add new distribution breakers as indicated.
  - .4 Install new main secondary service to line terminals of main breaker. Remove existing service feeder.
  - .5 Reconnect load terminals of distribution breakers to existing feeders.
  - .6 Connect load terminals of distribution breakers to new feeders.
  - .7 Disconnect existing neutral grounding.
  - .8 Check factory made connections for mechanical security and electrical continuity.
  - .9 Adjust breaker trip unit settings as per the coordination study.
  - .10 Program and set up Departmental Representative's metering following manufacturer's instructions and as instructed by Departmental Representative. Install remote BACnet converter in CSA 1 enclosure and connect to Departmental Representative's meter with Cat. 5E cable in 27 mmC.
  - .11 The existing BAS system at the Bedford Institute of Oceanography is from Delta. This Contractor shall be responsible to hire Delta's Manufacturer's Representative to connect the new digital meters for Holland and Murray Buildings to the Delta BAS network. Allow for all required wiring, raceway, integration and pay for all associated fees to provide a complete system.
  - .12 Have the service entrance board re-certified by CSA or equivalent certification agency approved in the Province of Nova Scotia prior to energization.
- .2 Murray Building:
  - .1 Relocate temporary panel from Holland Building to Murray Building and refeed from Holland Building.
  - .2 Provide temporary circuit extensions from distribution breaker feeder to temporary panel.
  - .3 Arrange and pay for Nova Scotia Power to de-energize the service to the building. De-energize the service entrance board and disconnect main secondary from line terminals of main breaker.
  - .4 Replace existing main breaker with new.
  - .5 Disconnect distribution feeders and replace existing distribution circuit breakers with new as indicated.
  - .6 Add new distribution breakers as indicated.
  - .7 Reconnect main secondary service to line terminals of main breaker.
  - .8 Reconnect load terminals of distribution breakers to existing feeders.

- .9 Connect load terminals of distribution breakers to new feeders.
- .10 Check factory made connections for mechanical security and electrical continuity.
- .11 Adjust breaker trip unit settings as per the coordination study.
- .12 Program and set up Departmental Representative's metering following manufacturer's instructions and as instructed by Departmental Representative. Install remote BACnet converter in CSA 1 enclosure and connect to Departmental Representative's meter with Cat. 5E cable in 27 mmC.
- .13 The existing BAS system at the Bedford Institute of Oceanography is from Delta. This Contractor shall be responsible to hire Delta's Manufacturer's Representative to connect the new digital meters for Holland and Murray Buildings to the Delta BAS network. Allow for all required wiring, raceway, integration and pay for all associated fees to provide a complete system.
- .14 Have the service entrance board re-certified by CSA or equivalent certification agency approved in the Province of Nova Scotia prior to energization.

### 3.2 MANUFACTURER'S FIELD VERIFICATION

- .1 Manufacturer's authorized factory trained service technician to:
  - .1 Verify service entrance board installation and connections.
  - .2 Check breaker trip unit settings against coordination study to ensure proper operation and protection of components.
  - .3 Verify and commission operation of surge suppression protection equipment.
  - .4 Verify and commission operation of Departmental Representative's metering.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

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

1.2 REFERENCE STANDARDS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Division 01 – General Requirements.
- .2 Include time-current characteristic curves for breakers with ampacity of 300 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Molded-case circuit breakers and ground-fault circuit-interrupters: to CSA C22.2 No. 5.
- .2 Bolt-on or bolt-in molded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications. Tie-bars are not acceptable.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers with interchangeable trips on units over 225 A.
- .6 600 V Circuit breakers: 65 kA (symmetrical) interrupting capacity for new SEB, 50 kA for retrofit SEBs.
- .7 Circuit breakers to be supplied by the same manufacturer as the panelboard or distribution board in which they are being installed.
- .8 Circuit breakers to be new, complete with original factory warranty and supplied from an authorized manufacturer's distributor.

2.2 THERMAL MAGNETIC BREAKERS

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

2.3 SOLID STATE TRIP BREAKERS

- .1 Molded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition with field adjustable settings for long time, short time and instantaneous tripping for phase and ground fault short circuit protection. Note that long time, short time and instantaneous settings must be **individually** adjustable.
- .2 Breaker field adjustable settings to be protected by removable clear plastic guard that allows visual verification of all breaker settings when in place. Breaker filler plates and wireway covers must not obscure visibility of settings.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers.
- .2 Use thermal magnetic breakers.

END OF SECTION