

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Sections of division 01 and 26 of technical specifications.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.10-10, Canadian Electrical Code, and Québec modifications.
 - .2 CSA C22.2 current version.
 - .3 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

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

1.4 DESIGN REQUIREMENTS

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

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Québec, Canada.

- .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
- .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .5 If changes are required, notify Departmental Representative of these changes before they are made.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control. Provide CSA certified equipment and material.
 - .1 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval.
 - .2 Submit test results of installed electrical systems and instrumentation.
 - .3 Permits and fees: in accordance with General Conditions of contract.
 - .4 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .4 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.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices 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 Site Meetings:
 - .1 Site Meetings: as part of Manufacturer's Field Services described in appropriate NMS Section, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.

- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

1.8 SYSTEM STARTUP

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

1.9 OPERATING INSTRUCTIONS

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

Part 2 Products

2.1 WARNING SIGNS

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

2.2 WIRING TERMINATIONS

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

2.3 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
- .1 Nameplates: lamicoid 3 mm thick melamine, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
- .2 Sizes as follows:
- | NAMEPLATE SIZES | | | |
|-----------------|-------------|---------|--------------------|
| Size 1 | 10 x 50 mm | 1 line | 3 mm high letters |
| Size 2 | 12 x 70 mm | 1 line | 5 mm high letters |
| Size 3 | 12 x 70 mm | 2 lines | 3 mm high letters |
| Size 4 | 20 x 90 mm | 1 line | 8 mm high letters |
| Size 5 | 20 x 90 mm | 2 lines | 5 mm high letters |
| Size 6 | 25 x 100 mm | 1 line | 12 mm high letters |
| Size 7 | 25 x 100 mm | 2 lines | 6 mm high letters |
- .2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.4 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.

2.5 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 15 kV	Yellow	Red
Other Communication Systems	Green	Blue

2.6 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 to EEMAC 2Y-1.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 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 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 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.

3.5 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
- .2 Provide a coordination study and setup appropriate protection relay's parameters of provided equipment.

3.6 FIELD QUALITY CONTROL

- .1 Conduct following tests in accordance with Section 01 45 00 - Quality Control.

- .1 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.
- .2 Carry out tests in presence of Departmental Representative.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.7 CLEANING

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Sections of division 26.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMJ-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in clean, dry, well-ventilated area in accordance with manufacturer's recommendations.
 - .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 Bushing stud connectors: to NEMA to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.

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.

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2..

3.3 CLEANING

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Sections de la division 26.

1.2 PRODUCT DATA

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets and packaging materials.

Part 2 Products**2.1 BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: , 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 Fastenings:
 - .1 One hole aluminum straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1000 mm centers.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.

- .8 Waterproof connectors:

2.3 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath : thermoplastic jacket.
- .2 Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: PVC.
 - .2 Shielding: metallized tapes over group.
 - .3 Overall covering: polyethylene jackets.
- .3 Type: 600 V stranded copper conductors, sizes as indicated:
 - .1 Insulation: PVC.
 - .2 Overall covering: thermoplastic jacket.

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 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

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

3.5 INSTALLATION OF CONTROL CABLES

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

END OF SECTION

Part 1 General**1.1 SECTION INCLUDES**

- .1 Materials and installation for connectors and terminations.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2
 - .2 CSA C22.2 No.41-M1987(R1999), Grounding and Bonding Equipment.

1.4 PRODUCT DATA

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

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

Part 2 Products**2.1 CONNECTORS AND TERMINATIONS**

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

Part 3 Execution**3.1 INSTALLATION**

- .1 Install terminations in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

END OF SECTION

Part 1 General**1.1 RELATED SECTIONS**

- .1 Sections de la division 26

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products**2.1 SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, suspended.
- .2 Toggle bolts with carbon steel anchors

Part 3 Execution**3.1 INSTALLATION**

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole 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.
- .8 For surface mounting of two or more conduits use channels spaced as per code requirements.-.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .13 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 REFERENCES

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 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.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling.

Part 2 Products**2.1 JUNCTION AND PULL BOXES**

- .1 Construction: welded steel enclosure.
- .2 Covers Surface Mounted: screw-on flat covers.

2.2 CABINETS

- .1 Construction: welded sheet steel hinged door, handle, lock 2 keys and catch Type E
Empty: surface return flange mounting as indicated.

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 SECTIONS**

- .1 Section 26 05 00 Common Works 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. 45-M1981(R2003), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.

1.3 SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products**2.1 CABLES AND REELS**

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

- .3 Identify cables for exclusively dc applications.
- .4 Reel and mark shielded cables rated 2,001 volts and above.

2.2 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, aluminum liquid-tight flexible metal.
- .4 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3.

2.3 CONDUIT FASTENINGS

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

2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 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.

2.6 FISH CORD

- .1 Polypropylene.

Part 3 Execution**3.1 MANUFACTURER'S INSTRUCTIONS**

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

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms in unfinished areas.
- .3 Surface mount conduits.
- .4 Use electrical metallic tubing (EMT).
- .5 Use flexible metal conduit for connection to motors in dry areas work in movable metal partitions.
- .6 Minimum conduit size for lighting and power circuits: 19 mm.
- .7 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .8 Mechanically bend steel conduit over 19 mm diameter.
- .9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .10 Install fish cord in empty conduits.
- .11 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .12 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

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

3.4 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 SCOPE OF WORKS**

- .1 This section specifies the modifications to the existing medium voltage switchgear and the retrofit or addition of new components as:
 - .1 Circuit Breakers
 - .2 Protection relays
 - .3 Breakers remote control
 - .4 New continuous current source

1.2 RELATED REQUIREMENTS

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

1.3 REFERENCES

- .1 Design, construction, materials and arrangement of all the equipment, components and accessories shall conform to standard practice and to the requirements of the latest edition or revisions of the following organization standards:
 - .1 Federal and Provincial Governments;
 - .2 Canadian Standard Associations (CSA);
 - .3 Electrical and Electronic Manufacturers Association of Canada (EEMAC);
 - .4 National Electrical Manufacturers Association (NEMA);
 - .5 Institute of Electrical and Electronic Engineers (IEEE);
 - .6 American National Standards Institute (ANSI);
 - .7 Commission electrotechnique internationale (CEI);
 - .8 The utility company.
 - .9 The applicable standards are not limited to the following:
 - .1 CSA C22.2 no. 31 "Switchgear Assemblies";
 - .2 CSA C22.2 no 14-95;
 - .3 EEMAC G8-2, G8-3.2, G8-3.3;
 - .4 NEMA SG3, SG4, SG5, SG6;
 - .5 ANSI C37.17, C37.20, C37.20.3, C37.20.4, C37.90, C39.1.
- .2 The manufacturer shall conform to the latest edition of the most stringent standards

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and technical data regarding Section 26 05 00 - Common Works Result for Electrical.
- .2 Submit shop drawings of :
 - .1 Medium voltage circuit breakers and protective relays;
 - .2 Metering instruments;
 - .3 Potential and current transformers;

- .4 Medium voltage circuit breaker ramp;
- .5 D.C. power supply.
- .3 Supply coordination time-current curves and coordination calculations for the following equipment:
 - .1 Medium voltage circuit breakers and relays;
 - .2 Medium voltage fuses.
- .4 Submit shop drawings to the utility for its approval.
- .5 Operation and maintenance manuals
 - .1 Supply all data and shop drawings, which are required to be included in the operation and maintenance manuals as stated in the article "Operation and Maintenance manuals" of the specifications.
 - .2 In particular, without being limited to, supply operation and maintenance instruction for:
 - .1 Medium Voltage circuit breakers and protective relays;
 - .2 Metering instruments;
 - .3 D.C. power supply.
- .6 Manufacturing requirements.
 - .1 All equipment must bear the CSA label.
 - .2 Units shall be designed to reduce installation, dismantling and maintenance costs to a minimum.

1.5 FACTORY TESTS TO PERFORM

- .1 The Engineer shall be witness to the final factory tests on the following equipment:
 - .1 Medium voltage circuit breakers.

Part 2 Products

2.1 MEDIUM VOLTAGE SUBSTATION (MODIFICATION)

- .1 Modify existing switchgear to install new components specified in this section.
- .2 Existing switchgear
 - .1 FPE, Federal Pioneer 3phases 4 fils
 - .2 Voltage : 25kV
 - .3 Capacité de cour circuit : 25kA.
 - .4 BIL=150kV.
 - .5 See annex B for shop drawings.
- .3 Electrical characteristics applicable to all components.
 - .1 Operating voltage
 - .1 Nominal voltage: 24.94 kV
 - .2 Maximum voltage: 27.6 kV
 - .2 Frequency: 60 Hz

- .3 Minimum insulation levels
 - .1 Nominal operating voltage: 24.94 kV
 - .2 Designated nominal: 25.0 kV
 - .3 Designated maximum: 27.0 kV
 - .4 Withstand (60 sec.): 60 kV
 - .5 B.I.L. (1.2 – 50 MS): 125 kV
- .4 Structure
 - .1 Breaker cubicle to be modified to fit new breaker.
 - .2 Relays cubicle door to be replaced as shown on drawings.
 - .3 Provide new breakers cradle.
 - .4 Assembly to be certified CSA
 - .5 Finish: ASA 61 light grey.
- .5 Bus Bars
 - .1 Modify existing buss bar to fit new breakers.
 - .2 Insulated supports having the solidity and in sufficient quantity to support the magnetic and mechanical stresses, which could affect the bus bars, without permanent deformation.
 - .3 Capacities as indicated and based on a 65 oC temperature rise for a 40 °C average ambient.
 - .4 Arrange bus bars and lugs to facilitate connection of cables or bus ducts according to compartment in each cell.
- .6 Control Wiring
 - .1 TBS or SIS type, no. 14 AWG stranded minimum, 600 V isolation.
 - .2 Both ends shall be identified. Red for current carrying circuits and white for the others.
 - .3 Rail mounted terminals bearing same identification as the connected wires. Provide 20% spare terminals for future.
- .7 Medium Voltage circuit breaker cell
 - .1 SF6 or vacuum type breaker.
 - .2 The circuit breaker shall have the following nominal values and/or characteristics:

	24.94	kV
Nominal designated voltage:	25.0	kV
Maximum designated voltage:	27.0	kV
Frequency:	60	Hz
Number of poles, wires:	3	
Continuous amperage:	1200	A
Maximum rupturing amperage (RMS, symmetrical):	25	kA
Admissible short time amperage (3 sec.) (RMS, symmetrical):	25	kA
Closing and latching amperage (RMS, asymmetrical):	68	kA

- .3 Circuit breaker control mechanism and lever
- .4 Red and green lights indicating that the circuit breaker is "open" or "close".
- .5 Manually operated from an energy storage mechanism and electrically actuated from a green trip push button and a red close push button with motorized spring charging mechanism. This mechanism is entirely contained in a separate housing showing the following indications:
 - .1 Circuit breaker "closed";
 - .2 Circuit breaker "open";
 - .3 Springs "charged";
 - .4 Springs "discharged".
- .6 The circuit breaker closing springs are charged with an electric motor. However a manually operated device with removable lever shall permit spring loading of the breaker closing mechanism. The circuit breaker may be closed with a push button and by a shunt closing coil.
- .7 The circuit breaker tripping springs are charged by the closing movement of the breaker. The circuit breaker is locked in the tripped position if the closing springs are not fully charged.
- .8 Tripping of the breaker is done by a push button and a tripping coil which also is activated by the overload and short circuit relays [and by the voltage relays] [and by an unacceptable power transformer temperature alarm contact].
- .9 The circuit breaker is of the draw out type with the following characteristics:
 - .1 The circuit breaker may be in any of the following positions:
 - Connected;
 - Test;
 - Disconnected.
 - .2 A set of fixed primary contacts is secured to the cell for the connection of the draw out breaker. Safety shutters cover these contacts when the breaker is in the disconnected position;
 - .3 Mechanical interlocks will prevent the extraction or insertion of the breaker when in the closed position;
 - .4 Cell mounted auxiliary contacts to indicate that the breaker is "connected" or "disconnected":
 - Four (4) N.O.;
 - Four (4) N.C.
- .10 Accessories:
 - .1 One (1) N.O. auxiliary contact to indicate that the springs are charged;
 - .2 Cell mounted auxiliary contacts to indicate that the circuit breaker is "open" or "closed":
 - Four (4) N.O.;
 - Four (4) N.C.
 - .3 All auxiliary contact terminals shall be connected to a unique terminal block mounted in an accessible compartment;
 - .4 Plug terminated control cable;
 - .5 Grounding contact;

- .6 Number of operations mechanical counter.
- .11 Possibility to lock the breaker out of its compartment
- .12 Circuit breaker control power supply
 - .1 The power supply for the closing/tripping coils, the pilot lamps, the spring loading motor, etc., shall be at 125 Vc.c from a "DC power supply" as described under the sub-article entitled "DC Power Supply";
- .8 Potential and Current Transformers
 - .1 Potential and current transformers to conform to CSA C13 standard.
 - .2 Nominal voltage, thermal, mechanical, dielectric and BIL characteristics of current and potential transformers shall be equal to or greater than those of the main bus bars.
 - .3 Medium voltage transformers are to be reused
 - .4 Medium voltage current transformers having the following characteristics:
 - .1 Insulation: 25 kV;
 - .2 Ratio: as shown;
 - .3 Accuracy: 0.3B2.0for metering; 2.5 L100 for protection;
 - .5 Medium voltage current transformers having the following characteristics
 - .1 Ratio: Use the feeder circuit breaker current setting divided by five (5) and round to next highest value;
 - .2 Accuracy: 0.3B0.5 for metering; 2.5L50 for protection.
 - .6 Supply potential and current transformers
- .9 Overcurrent relays with the following characteristics:
 - .1 Microprocessor driven;
 - .2 Mounted in a compact housing. Frontal IP52 and rear IP20
 - .3 60 Hz;
 - .4 Supply source: 24 to 250 Vdc.;
 - .5 Protection functions:
 - .1 Maximum phase current instant/delay (ANSI 50/51)
 - .2 Maximum ground current instant/ delay (ANSI 50/51N);
 - .3 Breaker fault (ANSI 79) ;
 - .4 Maximum inverse current (ANSI 46);
 - .5 Minimum voltage (ANSI 27/27S) ;
 - .6 Maximum voltage (ANSI 59) ;
 - .7 maximum/minimum frequency (ANSI 81H/81L);
 - .8 Selection of inverse time curves (inverse standard, inverse et extreme inverse) ;
 - .9 Definite time settings (2 sec, 4sec etc.);

- .6 Meter functions
 - .1 Phase current RMS;
 - .2 Voltage and frequency;
 - .3 Phase rotation;
 - .4 Active, reactive and apparent power;
- .7 Four (4) type C command contacts of 8A at 125Vcc
- .8 Power supervision circuit;
- .9 Non volatile memory.;
- .10 LEDs fault indicators;
- .11 Unit test button;
- .12 Communications:
 - .1 E-LAN connection
 - .2 Protocol Modbus TCP/IP
 - .3 Port RS-485;
- .13 Three (3) medium voltage current protection transformers, as described in sub-article "Potential and current transformers".
- .10 Mimic bus
 - .1 The front of the assembly shall bear a mimic bus showing energy flow and component symbols. It shall be made from glued and screwed plastic material.
 - .2 Modify mimic bus to the new configuration.
- .11 D.C. Power Supply
 - .1 Electrically operated low voltage circuit breakers, control relays, pilot lamps, etc. shall be supplied by a battery-charger unit described hereunder.
 - .2 Furthermore, controls for the medium voltage circuit breakers, all associated relays, pilot lamps, etc. and a remote command station shall also be supplied from the same unit.
 - .3 Batteries as specified in section 26 33 16.
 - .4 Battery charger as specified in section 26 33 43.:
 - .5 Provide a DC panel to feed switch gear as shown on drawings.
- .12 Interlocks
 - .1 The existing interlock system for load switches will remain.
 - .2 Electrical interlocks between two medium voltage circuit breakers is required to prevent the closing of one breaker if the other is closed or under a fault condition. These interlocks are applicable to the electric manual operation or the automatic operation of the circuit breakers. The mechanical closing mechanism for the circuit breaker shall not be operational.

- .13 General Cell Layout
 - .1 Existing Cell layout have to be respected. Replacement breakers will be installed in existing cells
 - .2 Cells layout as shown on drawings

Part 3 Execution

3.1 MEDIUM VOLTAGE SUBSTATION

- .1 Installation
 - .1 Unload, move, unpack, inspect and locate the equipment at the expected location and install according to instructions shown on the drawings and as recommended by the Manufacturer.
 - .2 Immediately perform a visual inspection of all equipment during its reception in order to expose any fault.
 - .3 Verify shut down of power from Hydro-Québec before start any works.
 - .4 Remove existing breakers.
 - .5 Modify switchgear cubicle to fit new breakers;
 - .6 Install circuit breakers and execute all connections.
 - .7 Verify the mechanical resistance of manufactured connections and their electrical resistance.
 - .8 Once the installation of the apparatus is completed, remove all foreign matter and dust from the equipment before energizing.
 - .9 Install and connect required wiring and conduits between power transformer, medium voltage compartments, low voltage compartments and control and monitoring equipment for the complete operation of the system.
 - .10 Install and connect auxiliary equipment such as D.C. power supply, circuit breaker test cabinets etc. and demonstrate its proper operation.
 - .11 Hand over to the Engineer all duly completed certificates (test conditions, meter readings etc.). Sign them with the Engineer as a witness and complete them under the Owner's supervision.
 - .12 Correct all deficiencies and defects without cost to the Owner.
- .2 Tests
 - .1 Execute on site tests according to article 7.5 of EEMAC standard G8.2 for tests on the existing installation.
 - .2 Execute start up tests as required by the utility.
 - .3 Insure manufacturer's services for the execution of tests required by him.
 - .4 In addition to the tests required by the manufacturer, execute all complete tests of all the installed equipment as described in the present article together with the final installation check before the final acceptance test.
 - .5 Inform the Engineer in advance of the test to insure his presence.

- .6 Supply qualified personnel, the equipment, instruments etc. in order to execute tests on the different electric systems to the Engineer's satisfaction.
- .7 Insure the good general operation of the installation and the operation, in particular, concerning the following:
 - .1 Security;
 - .2 Phase to phase and phase to neutral insulation level;
 - .3 Ground continuity;
 - .4 Resistance to ground.
- .8 Potential and current transformer tests.
 - .1 Insure that all potential transformer are correctly installed and connected, clean, undamaged and of the approved voltage class.
 - .2 Insure that current transformers are correctly installed and connected. Insure that shorting links are removed once the wiring is completed and tested for continuity (no open circuit) before energizing.
 - .3 Insure that wires to the metering relays and instruments are connected to the specified transformation ratio tap.
- .9 Metering relays and instruments testing.
 - .1 Insure that all relays are clean, correctly connected, undamaged and equipped with a test block.
 - .2 Adjust and calibrate overload relays according to approved coordination study.
 - .3 Verify all metering instruments to make sure they are in good working order and correctly installed and connected.
- .10 Verification and testing of the apparatus.
 - .1 Verify the alignment of circuit breaker contacts, the proper operation of its mechanism, controls and make adjustments. Fill in the " FIELD CIRCUIT BREAKER TEST REPORT" .
 - .2 Verify that the circuit breaker arc chambers, arc-quenching coils and main contacts are clean, undamaged and that the line and load connections, the adjustment taps are free moving.
 - .3 Verify all insulating supports and bus bar joints.
 - .4 Verify all tap connections to insure that they are firm and well executed.
 - .5 Verify the interlock system, auxiliary mechanism and the circuit breaker operation jointly with the operation of the protective relays.
 - .6 Verify that the 1,000 V megger resistance value of the bus bar, circuit breaker/switch assembly is greater than 3 megohms. Note all values.
 - .7 Perform calibration and tests on circuit breakers.

.11 Grounding tests

- .1 Inspect all means through which the electrical installation is grounded including conductors, cable clamps, ground connections and rods.
- .2 Insure that all circuits, equipment and conductor sheath grounds are continuous and permanent.
- .3 Note the resistance to ground of all system grounding connections measured with a megger.

.12 Circuit breaker test report

- .1 Fill in the attached FIELD CIRCUIT BREAKER TEST REPORT

FIELD CIRCUIT BREAKER TEST REPORT			Section 26 20 00
SUBSTATION _____	BREAKER NO.: _____	BRAND: _____	
TYPE: _____	SERIAL NO.: _____	NOMINAL VOLTAGE: _____	
INSTRUCTIONS: - Check off each verified item in "VERIF." column - Fill all blank spaces and enter results - Sign one copy and give it to the engineer			

1. VISUAL INSPECTION

ITEM	VERIF.
CONTACTS	
ARC CHUTES	
LUBRICATION	

2. OPERATION VERIFICATION

ITEM	VERIF.
ON-OFF TEST POSITION	
ELECT.-MECHAN. OPERATION	
ELECT.-MECHAN. INTERLOCK	

3. INSULATION RESISTANCE TEST

ITEM	VERIF.
BETWEEN POLES (AA', BB', CC')	
PHASE TO GROUND (A, B & C)	
PHASE TO PHASE (AB, BC, CA)	
TRIPPING CIRCUIT	

4. COMPONENT CHARACTERISTICS

ITEM	TYPE	RATING
FUSES		
PHASE SENSOR		
GROUND SENSOR		
CURRENT TRANSF		

5. MAIN CONTACTS RESISTANCE (DRAW-OUT AND BREAKER POLES)

A: _____, _____, _____ Micro-ohms; B: _____, _____, _____ Micro-ohms; C: _____, _____, _____ Micro-ohms.
--

6. VERIFICATION OF PROTECTION DEVICES TRIPPING WITH CURRENT INJECTION

ADJUSTMENTS	TYPE OF RELAY	ADJ. BAND	SPECIF. ADJUST	ADJ. AT	VERIF.
LONG DELAY	TAP DELAY				
SHORT DELAY	TAP DELAY				
INST.	TAP				
GROUND	TAP DELAY				
UNBAL.	TAP				

7. REMARKS AND RESULTS

VERIFICATION DONE BY: _____	COMPANY: _____
(SIGNATURE): _____	

END OF SECTION

Part 1 General**1.1 SUMMARY**

- .1 Section Includes:
 - .1 Materials and installation for storage batteries and racks.
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 35 29.06 - Health and Safety Requirements.
 - .3 Section 26 33 43 Battery Chargers
 - .4 Section 26 10 00 25kV Breakers

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Underwriters Laboratories (UL).
 - .1 ANSI/UL 96, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (ANSI Approved November 21, 2003).
- .2 Canadian Standards Association (CSA International).
 - .1 CAN3-Z299.3-85 (R2002), Quality Assurance Program - Category 3.
 - .2 AN/CSA-G40.20/G40.21-98 (R2003), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .3 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .5 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data to include:
 - .1 Dimensioned sketch showing battery rack, individual battery cells, recommended aisle space, headroom, assembly and anchoring of rack.
 - .2 Shipping weights.
 - .3 Individual battery cells, type, size, A.h capacity at 8 hours discharge rate, electrolyte, materials for container, cover, separators, retainers, posts and inter-cell connectors.
 - .4 Specific gravity at full charge and 25 degrees C.
 - .5 Cell charge and discharge curves of voltage, current, time and capacity.

- .6 Derating factor for temperature range (minus 10 degrees C to minus 30 degreesC).
- .7 Maximum short circuit current.
- .8 Maximum charging current recommended for fully discharged condition.
- .9 Full charge voltage per cell.
- .10 Fully discharged voltage per cell.
- .11 Hydrogen generation and ventilation requirements.
- .3 Closeout Submittals:
 - .1 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance and repair.
 - .2 Installation details of battery rack, individual cells, inter-cell connectors.
 - .3 Replacement instructions for individual cells.
 - .4 Electrolyte handling.
 - .5 Parts lists with catalogue numbers, and names and addresses of suppliers.
 - .6 Factory test records.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY STORAGE AND DISPOSAL

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for recycling.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Place materials defined as hazardous or toxic waste in designated containers.
 - .4 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.
 - .5 Ensure emptied containers are sealed and stored safely.

1.6 WARRANTY

- .1 For storage batteries, 12 months warranty period prescribed in General Conditions is extended to 24 months.

Part 2 Products

2.1 MATERIALS

- .1 Steel for battery racks: to CAN/CSA-G40.20.

2.2 BATTERY CHARACTERISTICS

- .1 Nominal battery voltage, full charge, 1.35 V.
- .2 The battery shall be built up of nickel-cadmium cells with alkaline pocket-plates, and having sufficient capacity to supply power to 11 MV breakers (2New + 9 Future), associated relays and status lamps for a period of five (5) hours, during a power failure, and for 10 circuit breaker close-open operations. The voltage at the end of the period shall be 105 Vd.c. at 20oC.
- .3 Minimum end voltage: 1.15 V per cell after discharge at rated load for period specified.
- .4 Capable of being recharged in period of 8 hours to not less than 95% full charge after supplying rated load for period specified, with no harmful effects on battery, including leaking or foaming of electrolyte.
- .5 Battery to deliver specified output at 25 degrees C, in ambient temperature from 20 degrees C to 40 degrees C.

2.3 NICKEL CADMIUM BATTERIES

- .1 Plates: perforated sheet steel, pocket type.
- .2 Cell containers: impact resistant translucent plastic.
- .3 Electrolyte: 20% solution of potassium hydroxide in water with special additives.
- .4 Vents: spring loaded flap type.
- .5 Inter-cell and inter-tier connectors: removable bolted type, plated copper, sized to carry battery maximum discharge current and clearance in fit to facilitate replacement of cells.
- .6 Cells: of identical construction and from same production run.
- .7 Cells and battery parts in clean state, with no evidence of electrolyte on cell cases or crystallization at vents.
 - .1 Clean cells prior to assembly into crates, and apply coating of vaseline to cell tops.

2.4 ACCESSORIES

- .1 Accessories: thermometer, hydrometer, torque wrenches for connector bolts and nuts, self- adhesive numbers for cell identification, lifting straps, no-oxide grease and heat sensing tape.
- .2 Two (2) spare inter-cell connectors, nuts and bolts.
- .3 Two (2) spare inter-tier connectors, nuts and bolts.

2.5 BATTERY RACK

- .1 2 tier 2 step,. Bottom tier minimum 120 mm above floor, top of battery cells on highest tier not more than 2 m above floor.

- .2 Frames: angle iron with welded joints ground smooth.
- .3 Rails: steel channels, bolted to frames.
- .4 Rubber strips to insulate rails from cells.
- .5 Insulated from ground and floor.
- .6 Free standing with anti-seismic protection.
- .7 Primed and epoxy painted to prevent corrosion.
- .8 Corrosion resistant bolts and hardware.
- .9 Configuration permitting any one cell to be removed without removing any other cell.
- .10 Dimensions of space available as indicated.

2.6 SOURCE QUALITY CONTROL

- .1 To CAN3-Z299.3.
- .2 Connect load designed to fully discharge battery to rated end voltage in 60 min.
- .3 Install dc indicating voltmeter and ammeter.
- .4 Charge battery to ensure cells fully charged. When voltage reaches steady state, record: ambient temperature, temperature of each cell, voltage of each cell, voltage of battery.
- .5 Discharge battery by applying load for 60 min, and record at 85%, 90%, 95% and 100% of rated discharge time: voltage of battery, load current, voltage of each cell, ambient temperature and battery temperature.
- .6 At completion of discharge test, recharge battery at maximum specified rate, and record at 15 min intervals: battery voltage, charging current.
- .7 At start and finish of charging cycle record ambient and battery temperatures, and specific gravity of each cell (lead acid only).
- .8 Submit copy of test results to Departmental Representative.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and erect battery rack.
- .2 Install battery cells on rack.
- .3 For nickel cadmium batteries, arrange vent flaps to open away from access side when cells placed in battery rack.

- .4 Clean posts and connectors and apply no-oxide grease.
- .5 Install inter-cell and inter-tier connectors, and hand tighten nuts in accordance with manufacturer's instructions.
- .6 Using torque wrenches, tighten nuts in accordance with manufacturer's recommended value.
- .7 Connect battery to load circuit.

3.2 FIELD QUALITY CONTROL

- .1 Check battery voltage and voltage of each cell in accordance with manufacturer's instructions.
- .2 Float charge battery for 8 hours to ensure battery fully charged and in stable condition.
- .3 Discharge battery at rated load for 5 hours.
- .4 Check battery voltage at terminals and voltage of each cell.
- .5 Recharge battery to full charge.
- .6 Check battery voltage and voltage of each cell.
- .7 Leave battery in fully charged state.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 00 Common works result for electrical
- .2 Section 26 10 00 25kV Breakers.
- .3 Section 26 33 16 Battery racks

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA C22.2 No.107.2-01(R2007), Battery Chargers.

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 battery chargers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Charger data: type and capacity, battery charging sequence, current time data for Silicon Controlled Rectifier (SCR) protective devices, estimated noise level, metering, alarms, controls and efficiency.
 - .3 Battery product literature
- .3 Shop Drawings:
 - .1 Include outline schematic diagrams with dimensions showing arrangement of cubicle, components, meters and controls.
- .4 Operation and Maintenance Data:
 - .1 submit operation and maintenance data for battery chargers for incorporation into manual.
 - .2 Submit operation and maintenance data for batteries
- .5 Operation and maintenance instructions covering design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance and repair.
- .6 Copy of approved shop drawings.
- .7 Technical description of components.
- .8 Parts lists with catalogue numbers and names and addresses of suppliers.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products**2.1 PERFORMANCE REQUIREMENTS**

- .1 Automatically maintain battery in fully charged state while mains power available. Maintain DC float voltage within plus or minus 1% of setting.
- .2 Equalize charging rate such that after battery has provided full power output for specified duration, charger returns battery to 95% of fully charged state in 8 hours.
- .3 Manually initiated equalize charging feature with automatic timer adjustable from 8 to 72 hours, to return unit to float charge.
- .4 Manual adjustment of float charge voltage with range plus or minus 5%.
- .5 Manual adjustment of equalizing charge voltage.
- .6 Automatic current limiting adjustable between 80 and 120% of normal rating.
- .7 Audible noise level not to exceed 65 dBA at 1.5 m.
- .8 **Battery charger capacity to be calculated to feed two (2) MV new breakers plus nine (9) future MV breakers and recharge batteries (total 11 breakers & associated protecting relaying, status lamps and battery recharge).**

2.2 CHARGER CHARACTERISTICS

- .1 Battery charger: to CAN/CSA C22.2 No.107.2.
- .2 Input: 208V Vac, 3 phase, 3 wire, 60Hz.
- .3 Output: DC at 125 V, DC, ripple voltage less than 2 %.

2.3 ACCESSORIES

- .1 Digital DC V&A meter , 1% accuracy switch selectable

- .2 General failure alarm, LED , dry contacts
- .3 AC failure alarm LED, dry contacts.
- .4 Low DC voltage alarm to indicate over discharge, red LED, dry contact set to 105V.
- .5 High DC voltage alarm and high DC voltage automatic shutdown.
- .6 Ground detector relay and alarm.
- .7 Equalizing timer: automatic reset type for unattended stations.
- .8 Filter to reduce ripple voltage in rectifier output from 2% to 100 mV.
- .9 LEDs mounted on front to indicate: failure AC power, low DC voltage, high DC voltage, no rectifier output.
- .10 Alarms: audible alarm when any LED indicates trouble. Silence pushbutton not to extinguish trouble light.
- .11 Common LED test switch and one common Form C alarm contact.
- .12 Cables and clips.
- .13 Temperature compensation system for voltage output, including remote, battery mounted, temperature sensor.

2.4 ENCLOSURE

- .1 CSA Enclosure Type 1, 2.5mm minimum thick..
- .2 Access from front.
- .3 Convection ventilated.
- .4 Meters, indicating lamps and controls group mounted on front panel.
- .5 Allow for handling by forklift or sling.
- .6 Apply finish in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Use size4 nameplates for major components such as input breakers, output breaker.
- .3 Use size2 nameplates for mode lights alarms, meters.

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

3.2 INSTALLATION

- .1 Locate and install battery charger as indicated.
- .2 Connect input terminals to AC mains.
- .3 Connect output terminals to battery.

3.3 TESTS

- .1 Energize battery charger and operate until battery shows full charge.
- .2 Discharge battery to full discharge condition.
- .3 Recharge battery, recording DC voltage and current once per hour for 8 hours. Test battery to ensure it has reached at least 95% full charge.
- .4 Continue charging to ensure charger changes from bulk rate to float charge rate.
- .5 Demonstrate that automatic timer controls charging and correctly transfers from equalize to float charge after selected period.
- .6 Simulate faults to demonstrate that alarm lights and audible alarms are performing as designed.
- .7 At end of tests, with battery in fully charged condition, operate charger on "float" for minimum period of 24 hours to ensure stable condition is reached and held.

3.4 CLEANING

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

- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

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

END OF SECTION