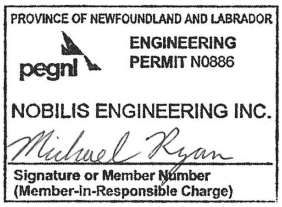
July 20, 2021 Project #: 1272-20

High Voltage Radar Station Installation
Marble Mountain
Steady Brook, NL



DRAWING NUMBER		DRAWING TITLE
E1	-	ELECTRICAL SITE DRAWING
E2	-	XFMR LOCATION & RADAR SITE DETAILS
E3	-	SWITCHGEAR SITE DETAILS
E4	-	SWITCHGEAR DETAILS
E5	-	ELECTRICAL SINGLE LINE
E6	-	U/G DETAILS
E6.1	-	XFMR PAD & BOLLARD DETAILS

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Description of Work.

.2 Contractor use of premises.

.3 Owner occupancy.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

Scope of Work: Work of this Contract generally entails the installation of new High Voltage conductors from the vicinity in and around the chair lift at the top of the ski hill to further up the mountain to the location of the new weather radar station.

.1 A new switchgear shall be installed. New conductors will be installed and terminated between the existing and new switchgear. New conductors shall be installed from new switchgear to a new distribution transformer(xfmr) at the radar station. New communications conductor shall be installed at the chair lift building at the top of the ski hill and run underground in the same trench as the HV conductors to the weather radar site. Make all terminations to communications equipment and power distribution equipment. New secondary conductors from the new padmount xfmr shall be installed in conduit to the electrical room of the weather radar station. All site work shall, including civil works shall be performed under this contract. The contractor shall coordinate all work with owner's representative.

.2 Work covered by the contract documents includes Commissioning of the installation.

1.3

.1 Submit a detailed construction schedule at the Pre-Construction meeting clearly indicating the sequence of events the anticipated time frame to complete each task, the manpower required and what tasks can be completed in conjunction during the same time frame. Indicate critical phases of the work and how the completion date will be met.

.2 The contractor should provide a plan to minimize the power outage to the owner's representative for approval, prior to work commencing. All work shall be completed in a safe manner. The existing switchgear is fed from xfmr further down the hill. There are a series of key interlocks between multiple pieces of equipment that will have to be de-energized in order to commence work.

.3 All work must be scheduled and co-ordinated with the owner's representative and the building administration well in advance of commencing demolition or construction.

.4 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Owner's Representative.

1.4 CONTRACTOR USE OF PREMISES

.1 Contractor has unrestricted use of site, under direction of owner's representative

.2 Coordinate use of premises under direction of Owner's Representative.

.3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

.4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.

.5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Owner's Representative.

1.5 OWNER OCCUPANCY

.1 Owner will occupy premises during entire construction period for execution of normal operations.

.2 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.6 RELATED WORK

.1 The following specification sections are referenced to indicate work responsibilities as specified and carried in other versions.

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

1.7 ON-SITE DOCUMENTS

.1 Maintain at job site documents on site. Provide red-lines for As-Builts.

1.8 CONTRACT DOCUMENTS

.1 Legends and schedules in the Issued for Tender Drawings take precedence over the Technical Specifications with respect to products and materials identified.

PART 2 EXECUTION (NOT APPLICABLE)

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

.1 This Section covers items common to Sections of Division 26 and Division 33.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

- .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
- .2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

1.3 CARE, OPERATION AND START-UP

.1 Instruct Owner's Representative and operating personnel in the operation, care and maintenance of systems, system equipment and components.

.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.

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. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SUBMITTALS

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.

.2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, and other items that must be shown to ensure coordinated 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 Quality Control:

.1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for approval before delivery to site.

.2 Submit test results of installed electrical systems.

.6 Single Line Electrical Diagrams

.1 Provide single line electrical diagrams in glazed frames as follows:

.1 Electrical distribution system: locate in main electrical room.

.2 Drawings: 600 x 600 mm minimum size.

1.6 PERMITS, FEES AND INSPECTION

.1 Submit to Electrical Inspection Division and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay associated fees.

.3 Owner's Representative will provide drawings and specifications required by Electrical Inspection Division and Supply Authority at no cost.

.4 Notify Owner's Representative of changes required by Electrical Inspection Division prior to making changes.

.5 Furnish Certificates of Acceptance from Electrical Inspection Division or authorities having jurisdiction on completion of work to Owner's Representative.

1.7 CO-ORDINATION

.1 Co-ordinate work with work ski hill operations and other contractors(divisions) on site to avoid conflict.

.2 Locate distribution systems, equipment, and materials to provide minimum interference and maximum usable space.

.3 Locate all existing underground services and make all parties aware of their existence and location. Marble Mountain Operations representative must be present prior to any digging.

.4 Where interference occurs, Owner's Representative must approve relocation of equipment and materials regardless of installation order.

.5 Notwithstanding the review of shop drawings, this division may be required to relocate electrical equipment which interferes with the equipment of other trades, due to lack of co-ordination by this Division. The cost of this relocation shall be the responsibility of this Division. The Owner's Representative shall decide the extent of relocation required.

1.8 CUTTING AND PATCHING

.1 Obtain written approval of Owner's Representative before drilling or cutting into any structures. Obtain written approval of Structural engineer and Owner's Representative before drilling any beams or floors.

1.9 PROTECTION

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark all live parts "LIVE 120 VOLTS", or with appropriate voltage in English.

1.10 RECORD DRAWINGS

.1 Obtain and pay for three sets of white prints. As the job progresses, mark these prints to accurately indicate installed work. Have the white prints available for inspection at the site at all times and present for scrutiny at each job meeting.

.2 Show on the record drawings the installed inverts of all services entering and leaving the building and the property. Dimension underground services at key points of every run in relation to the structure and building.

.3 Indicate exact location of all services for future work. Show and dimension all work embedded in the structure.

.4 Submit record drawings within 30 days prior to start of commissioning.

1.11 INSPECTION OF WORK

.1 The Owner will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications but will not execute quality control. The Contractor shall be responsible for the execution of his work in conformity with the construction documents and with the requirements of the inspection authority.

1.12 SCHEDULING OF WORK

.1 Work shall be scheduled in phases as required.

.2 Become familiar with the phasing requirements for the work and comply with these conditions.

.3 No additional monies will be paid for contractor's requirement to comply with work phasing conditions.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with the design documents and specifications.

.2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Division.

2.2 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 grey to EEMAC 2Y-1.

2.3 WARNING SIGNS

.1 As specified and to meet requirements of Electrical Inspection Department and Owner's Representative.

.2 Porcelain enamel decal signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

2.5 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: Lamicoid 3 mm thick plastic engraving sheet, black white face, black white 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

NAMEPLATE SIZES

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:

.1 Embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Owner's Representative prior to printing.

.4 Allow for average of twenty-five (25) letters per nameplate and label.

.5 Identification to be English (and French where applicable).

.6 Nameplates for terminal cabinets and junction boxes to indicate system name and voltage characteristics.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets and pull boxes: indicate system name and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages and transformer number.

2.6 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1, Canadian Electrical Code.

.4 Use colour coded wires in communication cables, matched throughout system.

PART 3 EXECUTION

3.1 NAMEPLATES AND LABELS

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

3.2 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.3 FIELD QUALITY CONTROL

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks – the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.

.2 The work of this division to be carried out by a contractor who holds a valid Code 1 Electrical Contractor License as issued by the Province.

.3 Perform tests in Accordance with this section and related sections

.4 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.5 Insulation resistance testing.

- .1 Megger and record circuits, feeders and equipment up to 350 V with a 500 V instrument.
- .2 Megger and record 350 – 600 V circuits, feeders and equipment with a 1000 V instrument.
- .3 Check resistance to ground before energizing and record value.

.6 Carry out tests in presence of Owner's Representative.

.7 Provide instruments, meters, equipment and personnel required to conduct tests during and conclusion of project.

.8 Submit test results for Owner's Representative's review and include in a Commissioning Manual.

3.4 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials rubbish, tools and equipment.

.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.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 This section specifies the furnishing, installation, and connection of medium-voltage cables, indicated as cable or cables in this section, and medium-voltage cable terminations.

1.2 RELATED SECTIONS

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

.2 Section 26 05 27 – Grounding-Primary

.3 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings

.4 Section 33 71 73.02 – Underground Electrical Service

1.3 PAYMENT PROCEDURES

.1 N/A

1.4 REFERENCES

.1 Canadian Standards Association (CSA)

.1 Canadian Electrical Code (CEC) C22.1

1.5 QUALIFICATIONS

.1 ASTM Specifications

.1 B3
.2 B8

.2 ANSI/ICEA S-94-649

.3 AEIC CS-8

.4 UL 1072

.5 RUS 1728F-U1

PART 2 PRODUCTS

2.1 MATERIALS

.1 Provide following materials:

.1 Cable shall be in accordance with ASTM, IEEE, NEC, NEMA and UL, and as shown on the drawings.Fuel lines and fittings as required.

.2 Single conductor stranded Aluminum conforming to ASTM B3.

.3 Voltage Rating: 15,000 V cable shall be used on all distribution systems with voltages ranging from 5,000 V to 15,000 V.

.4 Insulation:

.1 Insulation level shall be 133%.

.2 Types of insulation:

.1 Cable type abbreviation, EPR: Ethylene propylene rubber insulation shall be thermosetting, light and heat stabilized.

.2 Cable type abbreviation, XLP, XLPE, or TR-XLPE: cross-linked polyethylene insulation shall be thermosetting, light and heat stabilized, and chemically cross-linked.

.5 Insulation shield shall be semi-conducting. Conductor shield shall be semi-conducting.

.6 Insulation shall be wrapped with copper shielding tape, helically-applied over semi-conducting insulation shield.

.7 Heavy duty, overall protective polyvinyl chloride jacket shall enclose every cable. The manufacturer's name, cable type and size, and other pertinent information shall be marked or molded clearly on the overall protective jacket.

.8 Cable temperature ratings for continuous operation, emergency overload operation, and short circuit operation shall be not less than the NEC, NEMA WC 71, or NEMA WC 74 standard for the respective cable.

.9 All wiring and materials, including necessary rigid steel conduits and fittings for making connections.

2.2 TERMINATIONS

.1 Materials shall be compatible with the cables being spliced and terminated and shall be suitable for the prevailing environmental conditions.

.2 In locations where moisture might be present, the splices shall be watertight.

.3 Terminations:

.1 Shall comply with IEEE 48. Include shield ground strap for shielded cable terminations.

.2 Outdoor rated terminations: Kit with stress-relief tube, molded-silicone rubber insulator modules, and compression-type connector.

.3 Outdoor rated terminations: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.

.4 Provide insulated cable supports to relieve any strain imposed by cable weight or movement. Ground cable supports to the grounding system.

PART 3 EXECUTION

3.1 GENERAL

.1 Installation shall be in accordance with the latest edition of the CEC, as shown on the drawings, and manufacturer's instructions.

.2 Ground shields in accordance with grounding and bonding for electrical systems

.3 Cable maximum pull length, maximum pulling tension, and minimum bend radius shall conform with the recommendations of the manufacturer.

.4 Use suitable lubricating compounds on the cables to prevent pulling damage. Provide compounds that are not injurious to the cable jacket and do not harden or become adhesive.

.5 Seal the cable ends prior to pulling to prevent the entry of moisture or lubricant.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

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

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

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

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

- .1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

PART 2 PRODUCTS

2.1 MATERIALS

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

.2 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

- .1 Connector body and stud clamp for stranded copper conductors.
- .2 Clamp for copper bar.
- .3 Stud clamp bolts.
- .4 Bolts for copper bar.
- .5 Sized for conductors and bars as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

- .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
- .2 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

.2 Refer to drawings for wiring type required under different applications.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.

PART 2 PRODUCTS

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger.

.2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE and RWU90 XLPE as indicated. Provide RWU90 XLPE rated cable for underground wiring.

.3 Copper conductors: size as indicated, with thermoplastic insulation type TWH rated at 600 V, typically used for insulated ground wires.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

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

.2 Perform tests using method appropriate to site conditions and to approval of Owner's Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

.1 Install cable in trenches in accordance with Section 33 71 73.02 - Underground Electrical Service.

.2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).

.3 Conductor length for parallel feeders to be identical.

3.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34- Conduits, Fastenings and Fittings.

.2 In underground ducts in accordance with Section 26 05 43.01- Installation of Cables in Ducts.

.3 In trenches in accordance with Section 26 05 43.01- Installation of Cables in Trenches.

END OF SECTION

PART 1 GENERAL

1.1 INSTALLATION TOOLS

.1 Include with the material one complete set of installation tools. Tools to include all hydraulic pumps, fittings, compression dyes, cutting tools, measuring devices necessary to install all components.

PART 2 PRODUCTS

2.1 15KV TERMINATION KIT FOR

.1 Use 3M Medium Voltage Termination Kits for outdoor use and as recommended by the manufacturer

.2 Hydrophobic silicon body.

.3 High-K stress control.

.4 BIL rating 95 kV.

.5 Compatible with size #1/0 AWG stranded aluminum 15 kV cable.

.6 The exact kit selection will be based on the actual #1/0 AWG cable dimensions.

2.2 15KV CONNECTOR LUGS

.1 Suitable for use with a #1/0 AWG cable.

.2 The exact lug selection will be based on the actual #1/0 AWG cable dimensions.

2.3 TOOLS

.1 As per manufacturers requirements and recommendations.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install terminations, and splices in accordance with equipment and conductor manufacturer’s instructions.

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

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

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

1.2 REFERENCES

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).

.1 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association (CSA)

.1 CSA C22.2 No.0.4, Bonding and Grounding of Electrical Equipment (Protective Grounding).

1.3 SUBMITTALS

.1 Provided manufacturer's printed product literature, specifications, data sheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Rod electrodes: copper clad steel, 19 mm dia by 3 m long.

.2 Conductors: bare, stranded, un tinned soft annealed copper wire, size No 4/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections.

.3 Conductors: pvc insulated coloured green, stranded un-tinned soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.

.4 Conductors: pvc insulated coloured green, stranded un tinned soft annealed copper wire No. 10 AWG for grounding meter and relay cases.

.5 Bolted removable test links.

.6 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:

.1 Grounding and bonding bushings,
.2 Protective type clamps,
.3 Bolted type conductor connectors,
.4 Thermit welded type conductor connectors,
.5 Bonding jumpers, straps,
.6 Pressure wire connectors.

.7 Wire connectors and terminations: as indicated.

PART 3 EXECUTION

3.1 GROUNDING INSTALLATION

.1 Install continuous grounding system including, electrodes, conductors, connectors and accessories in accordance with CSA C22.2 No.0.4 and requirements of local authority having jurisdiction.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Use No. 4/0 AWG bare copper cable for main ground bus of switchgear & transformer and No. 2/0 AWG mhd bare copper cable for taps on risers from main ground bus to equipment.

.7 Use tinned copper conductors for aluminum structures.

.8 Do not use bare copper conductors near un-jacketed lead sheath cables.

Connections to Ground Bus Loop

All bonding and grounding conductors shall be copper. The connections to the ground bus or to the device being bonded / grounded shall be made using com- pression

connectors. Transformer tank bonding connections at the transformer tank and the ground bus loop shall be visible from the operating area of the vault.

The transformer tank shall not be bonded to the transformer secondary neutral terminal directly so that the tank does not become a path for neutral ground cur- rents. If they are bonded together then the transformer tank shall not have a separate bond to the ground bus loop.

Each bank of transformers shall have the tank bonds and the neutral ground (star point) connected to the ground bus loop within a 2,000mm space (aka Transform- er Ground Zone). This is to: To minimize the length of parallel ground paths.

- To minimize the length of circulating ground currents which cause additional equipment heating and EMFs that affect the occupancy and electrical equipment in adjacent rooms.

3.1.2 Transformer Tank Bonding

Transformer tank bonding shall be sized according to the following schedule.

Tanks of transformers	75 kVA	4/0 AWG
Circuit Breakers		2/0 AWG
All non-current carrying metal parts		4 AWG

Star Point Ground

The transformer secondary neutral bus shall be grounded in one location next to the transformer tank grounds (Transformer Ground Zone):

Transformer Bank	Secondary Voltage
	120/240V
1 x 75 kVA	250 MCM

3.2 EQUIPMENT GROUNDING

.1 Install grounding connections as indicated to typical station equipment including: metallic water main, line sky wire, neutral, gradient control mats. Non-current carrying parts of: transformers, generators, motors, circuit breakers, reclosers, current transformers, frames of gang-operated switches and fuse cutout bases. Cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers. Meter and

relay cases. Any exposed building metal, within or forming part of station enclosure. Sub-station fences, pothead bodies. Outdoor lighting.

3.3 NEUTRAL GROUNDING

.1 Connect transformer neutral and distribution neutral together using 600 V insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main station ground.

.2 Interconnect electrodes and neutrals at each grounding installation.

.3 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.

.4 Ground transformer tank with continuous conductor from tank ground lug through connector on ground bus to primary neutral. Connect neutral bushing at transformer to primary neutral in same manner.

3.4 CABLE SHEATH GROUNDING

.1 Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables.

.2 Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath.

.3 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

3.5 FIELD QUALITY CONTROL

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

.2 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Owner’s Representative and local authority having jurisdiction.

.3 Perform test before energizing electrical system.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

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

.2 Grounding conductors for all distribution grounding to be insulated copper, uninsulated where in contact with earth. Copper conductors shall, at a minimum, be used in the following areas: grounding of transformer neutrals, service entrance switch ground of neutral, padmount transformer grounding.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA)

.1 CEC CSA22.1.2021, Electrical Safety and Essential Electrical Systems in Health Care Facilities, where applicable.

PART 2 PRODUCTS

2.1 EQUIPMENT

.1 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

.2 Insulated grounding conductors: green, type TW.

.3 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors, as required by local authority having jurisdiction..
.4 Thermit welded type conductor connectors, as indicated.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run insulated copper ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive, electrodes, using copper welding by thermit process.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.2 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of secondary 240 V system.

3.3 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, building steel work.

3.4 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone system:

.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

3.5 FIELD QUALITY CONTROL

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

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Owner’s Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware, a National Standard of Canada.

.2 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

1.2 SUBMITTALS

.1 Product data: submit manufacturer's printed product literature, specifications and datasheets.

.1 Submit cable manufacturing data.

.2 Quality assurance submittals:

.1 Test reports: submit certified test reports.

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

.3 Instructions: submit manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 CONDUITS

.1 Rigid PVC conduit: to CSA C22.2 No. 211.2.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller. 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 1.5 m oc.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90º, 45 º or 22.5 º bends are required for 25 mm and larger conduits.

.3 Ensure conduit bends other than factory “ells” are made with an approved bender. Making offsets and other bends by cutting and rejoining 90 degree bends are not permitted.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install all conduit, conduit fittings and accessories in accordance with the latest edition of the Canadian Electrical Code in a manner that does not alter, change or violate any part of the installed system components or the CSA/UL certification of these components.

.2 Surface mount conduits except in finished areas or as indicated.

.3 Use rigid PVC(DB2) conduit underground and buried in or under concrete slab on grade.

.4 Install fish cord in all conduits.

.5 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.6 Dry conduits out before installing wire.

3.3 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Locate to suit reinforcing steel. Install in centre one third of slab. Use rigid PVC conduit.

.2 Protect conduits from damage where they stub out of concrete. Use rigid steel conduit for stub-up and adapt to in floor rigid PVC conduit.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

3.4 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

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

3.5 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.6 CLEANING

.1 On Completion and verification of performance of installation, remove surplus materials, excess materials rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

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

1.2 REFERENCES

.1 Canadian Standards Association, (CSA)

.2 Insulated Cable Engineers Association, Inc. (ICEA)

PART 2 PRODUCTS

2.1 CABLE PROTECTION

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

PART 3 EXECUTION

3.1 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.1 Do not pull spliced cables inside ducts.

.2 Install multiple cables in duct simultaneously.

.3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.6 After installation of cables, seal duct ends with duct sealing compound.

3.2 GPS MARKERS

.1 Contractor shall provide GPS coordinates along length of underground installation. Coordinates provided and marked on AS-Built drawings.

3.3 FIELD QUALITY CONTROL

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

.2 Perform tests using qualified personnel. Provide 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. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests.

- .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
- .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests

- .1 Ensure that terminations and accessory equipment are disconnected.
- .2 Ground shields, ground wires, metallic armour and conductors not under test.
- .3 High Potential (Hipot) Testing.
  - .1 Conduct hipot testing at 100 % of original factory test voltage in accordance with manufacturer's recommendations.
- .4 Leakage Current Testing.
  - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
  - .2 Hold maximum voltage for specified time period by manufacturer.
  - .3 Record leakage current at each step.

.7 Provide Owner’s Representative with list of test results showing location at which each test was made, circuit tested and result of each test. Include results in Commissioning Manual.

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

END OF SECTION

Functional Specification for Single-Phase Pad-Mounted Type Distribution Transformers 5–167 kVA

1.0 Scope

1.1 This specification covers the electrical and mechanical characteristics of Power 5–167 kVA Single-Phase Step-Down Pad-Mounted Distribution Transformers. Product is per catalog data EATONS POWER SERIES MODEL# CA201002EN OR EQUIVALENT.

2.0 Applicable Standards

2.1 All characteristics, definitions, and terminology, except as specifically covered in this specification, shall be in accordance with the latest revision of the following ANSI®, IEEE®, Department of Energy, and NEMA® standards.

2.2 IEEE Std C57.12.00™–IEEE Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

2.3 IEEE Std C57.12.38™ - IEEE Standard for Pad-Mounted-Type, Self-Cooled, Single-Phase Distribution Transformers 250kVA and Smaller: High Voltage, 34,500 GrdY/19920V and Below; Low Voltage, 480/240V and Below

2.4 IEEE Std C57.12.28™–IEEE Standard Pad-Mounted Equipment–Enclosure Integrity

2.5 IEEE Std C57.12.35™–IEEE Standard Bar Coding for Distribution Transformers and Step-Voltage Regulators

2.6 IEEE Std C57.12.90™–IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers

2.7 IEEE Std C57. 91™–IEEE Guide for Loading Mineral-Oil-Immersed Transformers and Step-Voltage Regulators

2.8 IEEE Std C57.154™IEEE Standard for the Design, Testing, and Application of Liquid-Immersed Distribution, Power, and Regulating Transformers using High-Temperature Insulation Systems and Operating at Elevated Temperatures

2.9 NEMA TR 1 (R2000)–Transformers, Regulators and Reactors, Audible Sound Levels for Liquid-Immersed Power Transformers

2.10 10 CFR Part 431–Department of Energy–Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule.

3.0 Ratings

3.1 The transformer shall be designed in accordance with this specification and shall have an Average Winding Rise (AWR) of one of the following:75°C

3.2 The transformer shall be designed in accordance with this specification and shall have a 75 kVA rating.

Table 1
Transformer and Connector High-Voltage Ratings and Electrical Characteristics for dead-front transformers

Transformer		Electrical Characteristics of the Completely Assembled High-voltage Connectors[1]			
		High-voltage Rating		BIL (kV)	60-Hz dry 1 minute withstand (kV)
High-voltage Ratings (V)	Minimum BIL (kV)	Phase-to-Ground (kV)	Phase-to-Ground /Phase-to-Phase (kV)		
Single High-Voltage					
4160GrdY/2400	60	8.3	8.3/14.4	95	34
8320GrdY/4800	75	8.3	8.3/14.4	95	34
12000GrdY/6930	95	8.3	8.3/14.4	95	34
12470GrdY/7200	95	8.3	8.3/14.4	95	34
13200GrdY/7620	95	8.3	8.3/14.4	95	34
13800GrdY/7970	95	8.3	8.3/14.4	95	34
16340GrdY/9430[2]	95	(8.3 or 15.2)[2]	(8.3/14.4 or 15.2/26.3)[2]	(95 or 125)[2]	(34 or 40)[2]
22860GrdY/13200	125	15.2	15.2/26.3	125	40
23900GrdY/13800	125	15.2	15.2/26.3	125	40
24940GrdY/14400	125	15.2	15.2/26.3	125	40
34500GrdY/19920	150	21.1	21.1/36.6	150	50
Series - Multiple High-Voltage					
4160GrdY/2400 x 12470GrdY/7200	95	8.3	8.3/14.4	95	34
4160Grdy/2400 x 13200GrdY/7620	95	8.3	8.3/14.4	95	34
8320GrdY/4800 x 24940GrdY/14400	125	15.2	15.2/26.3	125	40
12470GrdY/7200 x 24940GrdY/14400	125	15.2	15.2/26.3	125	40
13200GrdY/7620 x 24940GrdY/14400	125	15.2	15.2/26.3	125	40

1. For complete connector rating, see IEEE Std 386™

2 The required connector rating should be specified

The applicable voltage rating and BIL shall be specified on the inquiry.

3.3 The basic insulation level (BIL) of the secondary voltage shall be 30 kV.

Secondary voltage shall be 240/120 (3-Bushings)

3.4 The transformer shall be furnished with full capacity high-voltage taps. The tap-changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the tap-changer. The tap-changer shall be operable on the higher voltage only for transformers with dual voltage primaries. The unit shall have one of the following tap configurations: Two–2 ½% taps above and below rated voltage (split taps)

4.0 Construction

4.1 The core and coil shall be vacuum processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the transformer will be filled with preheated filtered degassed insulating fluid. The core shall be manufactured from burr-free, grain-oriented silicon steel and shall be precisely stacked to eliminate gaps in the corner joints or low-loss amorphous metal, depending on customer preference or optimal material based upon performance requirements. The coil shall be insulated with B-stage, epoxy coated, diamond pattern insulating paper, which shall be thermally cured under pressure to ensure proper bonding of conductor and paper.

4.2 The dielectric coolant shall be listed less-flammable fluid meeting the requirements of National Electrical Code Section 450-23 and the requirements of the National Electrical Safety Code (IEEE Std C2™-2002 standard), Section 15. The dielectric coolant shall be non-toxic*, non-bioaccumulating and be readily and completely biodegradable per EPA OPPTS 835.3100. The base fluid shall be 100% derived from edible seed oils and food grade performance enhancing additives. The fluid shall not require genetically altered seeds for its base oil. The fluid shall result in zero mortality when tested on trout fry*. The fluid shall be certified to comply with the US EPA Environmental Technology Verification (ETV) requirements, and tested for compatibility with transformer components. The fluid shall be Factory Mutual Approved®, UL® Classified Dielectric Medium (UL-EOUV) and UL® Classified Transformer Fluid (UL-EOVK), Envirotemp™ FR3™ fluid.
*Per OECD G.L. 203

4.3 All transformer components shall be certified to comply with industry standards when tested in Envirotemp™ FR3™ fluid. Certified test reports for each transformer component shall be provided upon request.

4.4 In addition to the regular locking provision, all access doors or hood shall be secured by a recessed, captive, penta head bolt that meets the dimensions set forth in Rural Utilities Service (RUS) Drawing A3759 or IEEE C57.12.38.

4.5 The transformer shall be of sealed tank construction of sufficient strength to withstand a pressure of 7 psig without permanent distortion, and 15 psig without rupturing or affecting cabinet security.

4.6 The exterior of the unit shall be painted Munsell 7GY3.29/1.5 green unless otherwise specified.

4.7 The tank shall include a pressure relief device as a means to relieve pressure in excess of pressure resulting from normal operation. The venting and sealing characteristics shall be as follows:

4.8 Cracking pressure: 10psig ± 2psig
4.9 Resealing pressure: 6psig minimum
4.10 Zero leakage from reseal pressure to -8psig
4.11 Flow at 15 psig: 35 SCFM minimum

4.12 The tank shall be complete with an anodized aluminum laser engraved nameplate. Nameplate shall conform to IEEE Std C57.12.00™, nameplate A.

4.13 High Voltage Bushings and Terminals

4.14 The high voltage bushings provided shall be externally clamped bushing wells. These wells shall be removable to allow for field replacement of the bushings without opening the tank.

4.15 The bushing configuration shall be per IEEE C57.12.38 Figure 1 (15 & 25 kV Class) and Figure 2 (35 kV Class) for ANSI® Type I units configuration.

4.15.1 A cable accessory parking stand shall be provided and shall be located such that the separable insulated connectors that are designed for operation after the transformer is in place can be operated with hot-line tools.

4.16 Low Voltage Bushings and Terminals

4.16.1 The configuration of the secondary bushings shall be per IEEE C57.12.38 Figure 1 (This specifies a horizontal or ANSI® Type I bushing arrangement) or Figure 3 (This specifies an angled or ANSI® Type II bushing pattern). These bushings shall be removable to allow for field replacement without opening the tank.

4.16.2 Transformer shall have threaded stud-type line and neutral terminals per Tables 2 and 3 below.

Table 2
Stud-type line and neutral terminals

LV bushing stud sizes	
Thread size Note 2	**Minimum L Note1/Note 2**
0.62-11 UNC-2A	31.75 (1.25)
1.000-14 UNS-2A	44.45 (1.75)
1.250-12 UNF-2A	63.5 (2.5)

NOTE 1 – Dimension "L" is in millimeters. Dimensions in parentheses are in inches. The tolerance is ±2mm (0.079 in).
NOTE 2 – Dimension "L" shall be the length of threads prior to any jam nuts, ground straps, or secondary connectors. Longer stud lengths may be required for user-supplied secondary connectors. Larger thread size or length, or both, may be required if materials other than copper are used. Stud thread sizes are in inches only

Table 3

	Required stud size for LV rating of:			
Transformer kVA size	**120 120/208Y**	**240 240/120 120/240**	**277**	**480 480/240 240/480**
10	0.625-11	0.625-11	0.625-11	0.625-11
15	0.625-11	0.625-11	0.625-11	0.625-11
25	0.625-11	0.625-11	0.625-11	0.625-11
37.5	0.625-11	0.625-11	0.625-11	0.625-11
50	1.00-14	0.625-11	0.625-11	0.625-11
75	1.00-14	0.625-11	0.625-11	0.625-11

100	1.00-14	1.00-14	0.625-11	0.625-11
167	1.250-12	1.00-14	1.00-14	0.625-11

NOTE 1 – Dimension "L" is in millimeters. Dimensions in parentheses are in inches. The tolerance is ±2mm (0.079 in).
NOTE 2 – Dimension "L" shall be the length of threads prior to any jam nuts, ground straps, or secondary connectors. Longer stud lengths may be required for user-supplied secondary connectors. Larger thread size or length, or both, may be required if materials other than copper are used. Stud thread sizes are in inches only

4.17 Overcurrent Protection

4.17.1 The protection scheme provided with the transformer shall consist of the following checked attributes. If for any reason a special protection scheme is required, it shall be clearly stated on the inquiry.

4.17.2 Standard – Over-current protection shall be provided by a Bay-O-Net expulsion fuse with a flapper valve to minimize oil spillage. The Bay-O-Net assembly shall be used in series with an internally mounted isolation link.

4.17.3 Overvoltage Protection

4.17.4 The protection scheme provided with the transformer shall consist of the following checked attributes. If a special protection scheme is required it shall be clearly stated on the inquiry.

Standard – No overvoltage protection is provided with the transformer.

Unit shall be provided with a Secondary overvoltage protection shall be provided by an externally mounted, high energy, ANSI approved light-duty distribution-class arrester.Storm Trapper H.E. (High Energy) low-voltage distribution-class surge arrester or equivalent.

5.0 Labeling

5.1 A temporary bar code label shall be attached to the exterior of the transformer in accordance with IEEE Std C57.12.35™.

6.0 Finish Performance Requirements

6.1 The tank coating shall meet all requirements in IEEE Std C57.12.28™ including:

6.2 Crosshatch adhesion
6.3 Humidity
6.4 Impact
6.5 Insulating fluid resistance
6.6 Ultraviolet accelerated weathering (QUV)
6.7 Abrasion resistance–taber abraser
6.8 Gravelometer

6.9 The enclosure integrity of the tank and cabinet shall meet the requirements for tamper resistance set forth in IEEE Std C57.12.28™ including but not limited to the pry test, pull test, and wire probe test.

7.0 Production Testing

7.1 All units shall be tested for the following:

No-Load losses at rated current*
Total losses at rated current**
Percent Impedance at rated current
Excitation current (100% voltage) test
Ratio tests using all tap settings
Polarity and phase relation tests
Induced potential tests
Full wave and reduced wave impulse test

7.2 *No load losses will be reported at 95°C or 20°C for 75°C AWR units, and 85°C or 20°C for 65°C and 65/75°C AWR units.

7.3 **Total losses and impedance values will be reported at 95°C for 75°C AWR units, and 85°C for 65°C AWR units.

7.4 The manufacturer shall provide the guaranteed average, no-load, and load losses for the unit when specified. These losses will be subject to the tolerance specified in Table 4.

Table 4
Tolerance for Transformer Losses

No-Load Losses (%)	Total Losses (%)
10	6

7.5 Transformers manufactured for sale in the United States and Canada shall conform to efficiency levels for liquid immersed distribution transformers, as specified in the Department of Energy ruling “10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule; April 18, 2013.” Manufacturer shall comply with the intent of all regulations set forth in noted ruling.

8.0 Approved Manufacturers

8.1 Eaton’s Cooper Power Systems Division

9.0 Accessories

9.1 The following checked accessories shall be provided:

9.2 Stainless steel hardware
9.3 Stainless steel tank, sill, door
9.4 Stainless steel pedestal (bottom 1.5” of tank), sill, door
9.5 Stainless steel nameplate
9.6 Mounting cleats
9.7 Lifting bolts

9.8 Tank ground connector
9.9 ½" drain valve with sampling device
9.10 Oil level gauge (dial-type)
9.11 Thermometer (dial-type) without contacts
9.12 Barrier between high voltage and low voltage
9.13 Poly-pad combination shipping/mounting pad (10-75 kVA)
9.14 Canadian Standards Association (CSA) and Consumer Electronics Association (CEA) designs

10.0 Shipping

10.1 The unit shall be banded, blocked, or bolted to a wood pallet or poly-pad.

11.0 Service

11.1 The manufacturer of the transformer shall have regional service centers located within 2 hours flight time of location. Service personnel shall be factory trained in commissioning and routine service of quoted transformers.

PART 1 GENERAL

1.1 SCOPE OF WORK

.1 Testing and commissioning are called for throughout the individual specifications. This does not relieve this trade from providing all testing and commissioning necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.

1.2 SECTION INCLUDES

.1 Commissioning of all electrical systems and component including:

.1 Testing and adjustment.
.2 Demonstrations.
.3 Instructions of all procedures for Owner's personnel.
.4 Updating as-built data.
.5 Co-ordination of Operation and Maintenance material.

1.3 RELATED SECTION

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

1.4 REFERENCES

.1 CSA (Canadian Standards Association).

.2 Underwriters Laboratories of Canada.

1.5 QUALITY ASSURANCE

.1 Provide qualified trades persons, certified testing agencies, factory trained and approved by the Commissioning Team Leader.

.2 Submit the names of all personnel to be used during the Commissioning activities for Owner Approval.

1.6 COMMISSIONING

.1 The purpose of the commissioning process is to fully test all systems including mechanical and electrical components and operating procedures by challenging these systems to realistic operation conditions as recommended by the manufacturer.

.2 The Commissioning activities shall be co-ordinated by the General Contractor.

.3 Commissioning activities for the electrical systems must have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.

.4 Contractor shall be responsible to update all documentation with information and any changes duly noted during the Commissioning exercise.

.5 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification. The cost associated with this requirement shall be included as part of the tender price.

1.7 SUBMITTALS

.1 A commissioning document shall be prepared by the Owner's Representative prior to conducting these activities for use by the Commissioning Team.

.2 The electrical sub-contractor shall be responsible for ensuring all activities are properly documented in this manual and co-ordinated through the General Contractor.

.3 As-built drawings and data books must be available two weeks prior to commissioning for review and use by the consultant and Commissioning Team prior to the start of the commissioning activities.

1.8 PREPARATION

.1 Provide test instruments required for all activities as defined in the commissioning documents.

.2 Verify all systems are in compliance with the requirements of the commissioning documents and manufacturer's requirements prior to the precommissioning check out operation.

.3 Confirm all scheduled activities have identified personnel available.

.4 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

1.9 SYSTEM DESCRIPTION

.1 Perform all start up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined in the commissioning documentation and as recommended by the manufacturer.

.2 Owner will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.

.3 Prepare and insert additional data in the operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the commissioning exercise.

1.10 FINAL REPORT

.1 This trade shall assemble all testing data and commissioning reports and submit them to the Owner.

.2 Each form shall bear signature of recorder, and that of supervisor of reporting organizer.

1.11 SCHEDULE OF ACTIVITIES

.1 Commissioning activities shall be conducted based on pre-established schedule with all members of the commissioning team.

.2 In addition, there will be two meetings held through the contract duration to introduce the parties of the commissioning team, establish the schedules and deadlines for the various activities and review the Commissioning Manual.

.3 Adhering to the established schedule is very important as the co-ordination and scheduling of the participants will be difficult to alter once this is established. Close co-ordination of this schedule is important.

.4 In the event project cannot be commissioned in the allotted time slot, the contractor shall pay for all costs associated with assembling the Commissioning Team at a later date. If the contractor has not performed his duties to reach commissioning stage as outlined earlier, he will incur all expenses of other trades and the Commissioning Team due to his non-compliance.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

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

.2 Section 26 05 27 – Grounding – Primary.

1.2 REFERENCES

.1 Canadian Standards Association (CSA),

.1 CAN/CSA-A3000, Cementitious Materials Compendium. Includes:

.1 CAN/CSA-A5, Portland Cement

.2 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.3 CSA G30.3, Cold-Drawn Steel Wire for Concrete Reinforcement.

.4 CSA G30.5, Welded Steel Wire Fabric for Concrete Reinforcement.

.5 CSA-G30.18, Billet-Steel Bars for Concrete Reinforcement.

.2 American Society for Testing and Materials (ASTM),

.1 ASTM D1056, Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.

1.3 SUBMITTALS

.1 Submit manufacturer’s test data and certification at least two (2) weeks prior to commencing work.

.2 Submit manufacturer’s information data sheets and instructions.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer’s recommendations.

1.5 RECORD DRAWINGS

.1 Provide record drawings, including details of pipe and duct bank materials, maintenance and operating instructions.

PART 2 PRODUCTS

2.1 PVC DUCTS AND FITTINGS

.1 Rigid PVC duct and conduit for exterior underground site wiring below concrete floor slabs, size as indicated to CSA C22.2, with moulded fittings and minimum wall thickness at any point of 2.8 mm. Nominal length: 3.0 m plus or minus 12 mm.

.2 Rigid PVC split ducts as required.

.3 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make complete installation.

.4 Rigid PVC 90º and 45º bends.

.5 Rigid PVC 5º angle couplings.

.6 Expansion joints as required.

.7 Preformed, interlocking intermediate duct spacers for duct size as indicated.

2.2 SOLVENT WELD COMPOUND

.1 Solvent cement for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

.1 Pulling iron: galvanized steel rods, size and shape as indicated.

.2 Pull rope: 6 mm stranded nylon polypropylene, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.

2.4 CONCRETE & REINFORCEMENT

.1 Coordinate with civil site contractor

2.5 MARKERS

.1 Provide 150 mm wide, 4 mil, polyethylene marker tape in all trenches. Use red colored tape. Install at depth as per drawings.

2.6 DUCT SPACERS

.1 As required for installation at 900 mm center – center.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

.1 Install underground duct banks and manholes including formwork.

.2 Build duct bank on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 95% of maximum proctor dry density.

.3 Open trench completely between connections before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.

.4 Prior to laying ducts, construct "mud slab" not less than 75 mm thick.

.5 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.

.6 Install base spacers at maximum intervals of 900 mm levelled to grades indicated for bottom layer of ducts.

.7 Lay PVC ducts with configuration as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 75 mm horizontally and vertically. Stagger joints in adjacent layers at least 150 mm and make joints watertight. Encase duct bank with 75 mm thick concrete cover.

.8 Make transpositions, offsets and changes in direction using 5 degree bend sections, do not exceed a total of 20 degree with duct offset.

.9 Use bell ends at duct terminations in manholes or buildings.

.10 Use conduit to duct adapters when connecting to conduits.

.11 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.

.12 Cut, ream and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.

.13 Allow concrete to attain 50% of its specified strength before backfilling.

.14 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.

.15 Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.

.16 Immediately after placing of concrete, pull through each duct wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling-in cables.

.17 Install four 3.0 m lengths of 15M reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings. Wire rods to 10M dowels at manhole or building and support from duct spacers. Protect existing cables and equipment when breaking into existing manholes. Place concrete down sides of duct bank filling space under and around ducts. Rod concrete with flat bar between vertical rows filling voids.

.18 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.2 MARKERS

.1 Mark ducts every 150 m along straight runs and changes in direction.

.2 Provide drawings showing locations of markers.

3.3 INSPECTIONS

.1 Inspection of duct will be carried out by Owner’s representative prior to placement of concrete.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

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

.2 Section 33 65 73 – Concrete Encased Duct Banks

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 211.1, Rigid Types EBI and DB2/ES2 PVC Conduit.

1.3 SUBMITTALS

.1 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada, and Health and Welfare Canada for solvent cement. Indicate VOC content.

.2 Submit manufacturer's data and certification at least 2 weeks prior to commencing work.

.3 Submit manufacturer's information data sheets and instructions.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and Handle materials in accordance with manufacturer's requirements

1.5 RECORD DRAWINGS

.1 Provide record drawings, including details of pipe and cable duct materials, maintenance and operating instructions.

PART 2 PRODUCTS

2.1 PVC DUCTS AND FITTINGS

.1 Rigid PVC duct: to CSA C22.2 No. 211.1, type rigid PVC for direct burial with minimum wall thickness at any point of 2.8 mm. Nominal length: 3.0 m plus or minus 12 mm. Type DB2 (thinwall) PVC conduits unacceptable.

.2 Rigid PVC split ducts as required.

.3 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make complete installation.

.4 Rigid PVC 90^{o} and 45^{o} bends as required.

.5 Rigid PVC 5^{o} angle couplings as required.

.6 Expansion joints as required.

.7 Preformed, interlocking intermediate duct spacers for duct size as indicated.

2.2 SOLVENT WELD COMPOUND

.1 Solvent cement for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

.1 Use 6 mm stranded nylon pull rope tensile strength 5 kN.

2.4 MARKERS

.1 150 mm wide, 4 mil, polyethylene marker tape in all trenches. Use red colored tape. Install at depth as per drawings.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install duct in accordance with manufacturer's instructions.

.2 Clean inside of ducts before laying.

.3 Ensure full, even support every 1.5 m throughout duct length.

.4 Slope ducts with 1 to 400 minimum slope.

.5 During construction, cap ends of ducts to prevent entrance of foreign materials.

.6 Pull through each duct wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.

.7 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.

.8 Install markers as required.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Provision of rigid conduit and concrete - encased underground service ducts.

1.2 RELATED SECTIONS

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

.2 Section 26 05 27 – Grounding – Primary.

.3 Section 26 05 28 - Grounding - Secondary.

.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.

1.3 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Conductors: As indicated on drawings.

.2 Concrete: to CSA A23.1/A23.2

.3 Ground at enclosure as per Section 26 05 27 - Grounding – Primary.

.4 Backfill: clean and free from debris.

.5 Pulling Iron:

.1 22 mm diameter hot dipped galvanized steel bar with exposed triangular shaped opening.

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 cables in existing ducts in accordance with Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts.

.2 Allow adequate conductor length for all connections.

.3 Allow adequate conductor length for connection to service equipment.

.4 Make grounding connections in accordance with Section 26 05 27 - Grounding - Primary.

.5 Install pulling irons as required.

.6 Seal ducts, conduits and cables from water ingress at building entrance location after installation of cable. Use POLYWATER FST DUCT SEALANT FST-250KIT1 WATER BLOCK FOAM KIT FROM AMERICAN POLYWATER CORP. INSTALL PER MANUFACTURERS RECOMMENDATIONS.

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3.3 FIELD QUALITY CONTROL

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

.2 Perform additional tests as required by authority having jurisdiction.

.3 Submit written test results for review and approval.

3.4 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION