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| Version | Date | Description of Revisions |
| 1 | August 30, 2006 | Approved final document. |
| 2 | February 19, 2010 | Modified ‘Related Sections’ and approved suppliers |
| 3 | June 10, 2013 | Final Draft – Consolidated Comments Spec Update Project |
| 4 | June 19, 2013 | Incorporation of new Commissioning Specification cross reference. Incorporated several aspects of the NL building specifications. |
| 5 | July 30, 2014 | Changes to reflect renaming of commissioning specification and final review (AV) |
| **6** | **February 9, 2015** | **Updated, Finalized Specification – Reference eDOCS #5630514 v5 (AV)** |
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NOTE:

This is a CONTROLLED Document. Any documents appearing in paper form are not controlled and should be checked against the on-line file version prior to use.

**Notice:** This Document hardcopy must be used for reference purpose only.

**The on-line copy is the current version of the document.**

# GEneral

## Related Sections

### [Under "Related Sections", identify other Sections that are related to, and/or dependent on, the work results or information specified elsewhere. The list should be limited to Sections with specific information that the reader might expect to find in this Section, but is specified elsewhere. For example, if hardware for aluminum entrances is specified in the aluminum entrance Section, a cross-reference would be appropriate in the finish hardware Section. The purpose of this cross-referencing is for information only, to aid in finding those other requirements—not to define the scope of the Section.

### Cross-referencing here may also be used to coordinate assemblies or systems whose components may span multiple Sections and which must meet certain performance requirements as an assembly or system.

### Contractor is responsible for coordination of the Work. Contractor is responsible for being familiar with and incorporating all required elements of cross-referenced Specifications cited.

### This Section is to be completed/updated during the design development by the Consultant. If it is not applicable to the section for the specific project it may be deleted.]

### [List Sections specifying installation of products supplied but not installed under this Section and indicate specific items.]

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Execution requirements for ...[item]... specified under this Section.

### [List Sections specifying products installed but not supplied under this Section and indicate specific items.]

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Product requirements for ...[item]... for installation under this Section.

### [List Sections specifying related requirements.]

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: [Optional short phrase indicating relationship].

### Section 01250 – Substitutions

### Section 01425 – Computerized Maintenance Management System Data Requirements

### Section 01810 – Equipment Testing and Facility Commissioning

### Section 01820 - Demonstration and Training

### Section 16010 – Electrical General Requirements

### [Division 13 – SCADA and Instrumentation - insert applicable specifications]

### Product requirements for [item]... for installation under this Section.

## References

[Delete .1 if Section 01060 – Regulatory Requirements is included in Contract Documents.]

### Comply with the latest edition of the following statutes, codes, standards, and all amendments thereto:

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

##### ANSI/IEEE 837-2014, IEEE Approved Draft Standard for Qualifying Permanent Connections Used in Substation Grounding.

##### ANSI/NEMA GR 1-2007, Grounding Rod Electrodes and Grounding Rod Electrode Couplings

#### Canadian Standards Association (CSA)

##### CAN/CSA-C22.2 NO. 0.4-04 (R2013), Bonding of Electrical Equipment.

##### C22.2 No. 41-13, Grounding and bonding equipment (Tri-national standard, with NMX-J-590-ANCE and UL 467).

#### Ontario Electrical Code (OEC)

## Measurement and Payment

*[Choose one of the following payment language provisions that best suits the individual project.*

*If this Section is not specifically referenced by an item in the Bid Form, please use the following language:*

### The work of this Section will not be measured separately for payment. All costs associated with the work of this Section shall be included in the Contract Price.

*OR If this Section is specifically referenced in the Bid Form, use the following language and identify the relevant item in the Bid Form:*

### All costs associated with the work of this Section shall be included in the price(s) for Item No(s). \_\_\_ in the Bid Form.

*If the work of this Section is to be measured and paid for by several different methods, please amend the standard wording given above to reflect the different methods of measurement and payment.*]

## Submittals

### Provide the manufacturer’s printed product literature, specifications, data sheet and include product characteristics, performance criteria, physical size, finish and limitations.

### Manufacturer’s Instructions: submit the manufacturer’s installation instructions and special handling criteria, installation sequence and cleaning procedures.

# PRODUCTS

## Ground Fault Indicator

### Approved Suppliers:

#### Schneider Canada Inc. (Square D).

#### Schneider Canada Inc. (Federal Pioneer).

#### Approved Equivalent.

## Materials

### Rod electrodes: copper clad steel, 19 mm in diameter by 3 m long.

### Plate electrode: copper surface area with sizes as indicated on the Contract Drawings.

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

### Conductors: PVC insulated coloured green, stranded soft annealed copper wire, size in accordance with the Ontario Electrical Safety Code for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, and potential transformers.

### Bolted removable test links.

### Accessories: non-corroding, necessary for complete grounding system, type, size material shall be as indicated in the Contract Documents, including, but not limited to, the following:

#### Grounding and bonding bushings,

#### Protective type clamps,

#### Bolted type conductor connectors,

#### Thermit welded type conductor connectors,

#### Bonding jumpers and straps,

#### Pressure wire connectors.

# EXECUTION

## Grounding Installation

### Install continuous grounding system including, electrodes, conductors, connectors and accessories in accordance with the requirements of CSA C22.2 NO. 0.4-04 (R2013) and the ESA.

### Ground fences to the grounding system independent of the station ground.

### Install connectors in accordance with the manufacturer's instructions.

### Protect exposed grounding conductors from mechanical injury and other damage.

### Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process. The Contractor shall provide the Consultant with GPS coordinates for all buried connections.

### Use mechanical connectors for grounding connections to equipment provided with lugs. Connections shall be clearly shown on the Site plan and grounding grid drawing.

### Use No. 4/0 AWG bare copper cable for the main ground bus of the substation and No. 2/0 AWG medium hard drawn bare copper cable for taps on risers from the main ground bus to the equipment.

### Use tinned copper conductors for aluminum structures.

### Do not use bare copper conductors near existing unjacketed lead sheath cables.

### Install grounding resistor bank.

### Install zig zag grounding transformer.

## Electrode Installation

### Install ground electrodes. Make grounding connections to the station equipment.

### Install ground rod electrodes at transformer and switchgear locations.

### Install gradient control mats. Connect mats to the station ground electrode and switch mechanism operating the rods.

### Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

## Equipment Grounding

### Install grounding connections as indicated in the Contract Documents to the typical station equipment and as per Ontario Electrical Code including: metallic water main, line sky wire, neutral, gradient control mats. Non-current carrying parts of: transformers, generators, motors, circuit breakers, re-closers, 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 the station enclosure. Sub-station fences, pothead bodies, and outdoor lighting.

### Ground hinged doors to the main frame of the electrical equipment enclosure with a flexible jumper.

### Connect metallic piping (water, oil, air, etc.) inside the station to the main ground bus at several locations, including at each service location within the station.

## Neutral Grounding

### Connect the transformer neutral and distribution neutral together using 1000 V insulated conductor to one side of the ground test link, the other side of the test link being connected directly to the main station ground. Ensure that the distribution neutral and the neutrals of the potential transformers and service banks are bonded directly to the transformer neutral and not to the main station ground.

### Interconnect electrodes and neutrals at each grounding installation.

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

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

## Pole Mounted Switching Device Grounding

### Drive four ground rods 3 m long at the base of each pole on which the group operated line switching devices are mounted.

### Arrange rods in square formation with 3 m sides, located so that the operator must stand within the square to operate the switch.

### Interconnect ground rods with No. 2/0 AWG stranded annealed copper conductor and join to the switch operating handle ground wires.

### Connect the operating handle of the switch to handle the base with No. 3/0 AWG extra flexible copper conductor.

## Pole Mounted Transformer Grounding

### Drive ground rods at the base of each pole on which the transformers are mounted and interconnect the transformer, system neutral, lightning arresters and ground rods.

## Grounding in Manholes

### Install a conveniently located grounding stud, electrode, size as shown on the Contract Drawings, stranded copper conductor in each manhole.

### Install a ground rod with a lug for the grounding connection in each manhole so that the top projects through the bottom of the manhole.

## Cable Sheath Grounding

### Bond single conductor, metallic sheathed cables together at one end only. Leave the load end of the ground floating.

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

### Connect bonded cables to the ground with a No. 2/0 AWG copper conductor.

## Field Quality Control

### Perform earth loop tests and resistance tests using the method appropriate to Site conditions and to the approval of the Consultant and local authority having jurisdiction. The test report shall be submitted to the Consultant and Region for approval in an electronic format suitable for up-load to the Region’s CMMS (Maximo). Refer to Section 01425 – Computerized Maintenance Management System Data Requirements.

### Perform all required tests before energizing the electrical system.

#### Engage a testing agent to inspect the grounding and to perform resistance testing before backfill.

## Commissioning

### For all commissioning activities on systems where components of this Section are integral to functionality, refer to Section 01810 – Equipment Testing and Facility Commissioning. All inspection and testing activities shall be completed in accordance with the commissioning plan that shall be provided to the Consultant prior to the commencement of commissioning activities.

**END OF SECTION**