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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:

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

# GEneral

## Related Sections

### 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

## References

### 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 Safety Code (OESC), 28th Edition, 2021.

## Measurement and Payment

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

## 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

## 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.

## 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 and get approved prior to the commencement of commissioning activities.

**END OF SECTION**