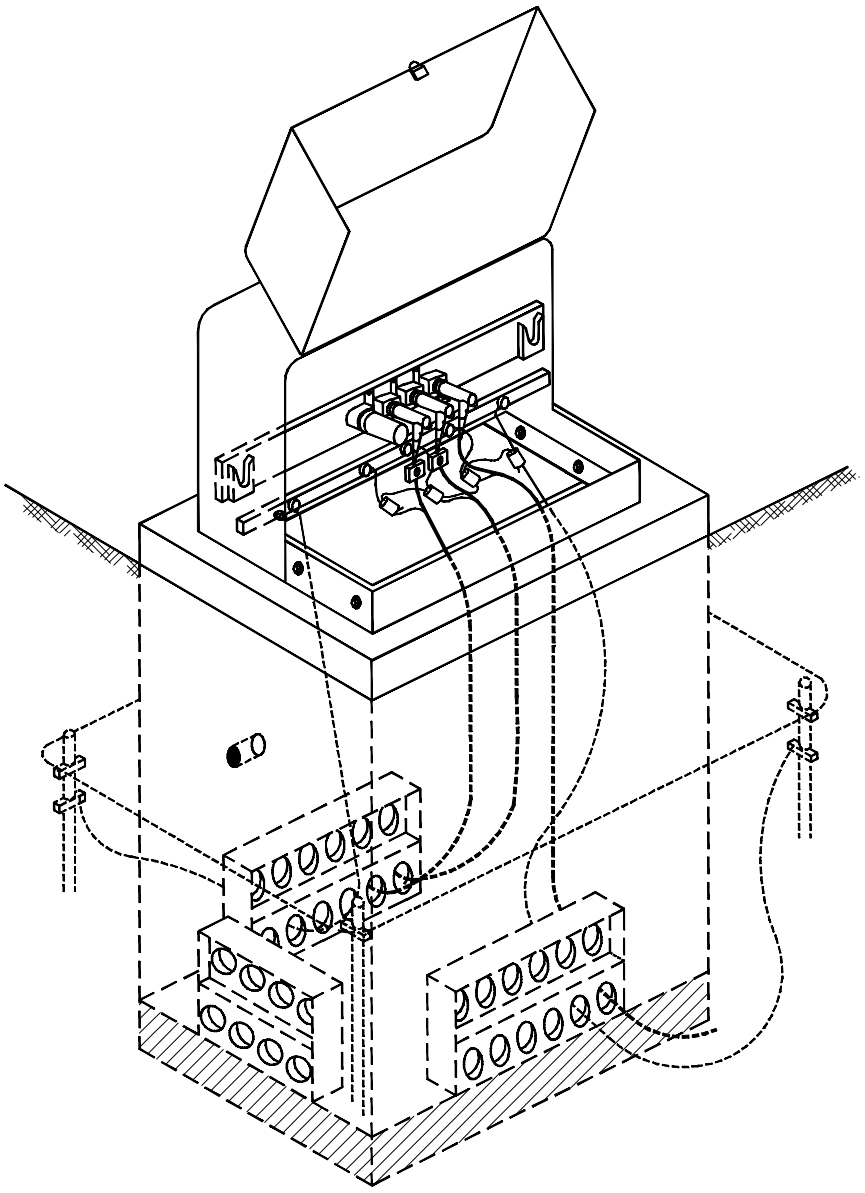
UNDERGROUND DISTRIBUTION STANDARDS



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UNDERGROUND DISTRIBUTION STANDARDS

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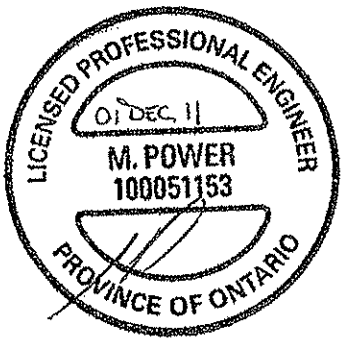
November 23, 2011

The Hydro One Underground Distribution Standards - 2011 edition, contain specifications and drawings for the construction and modification of the distribution underground network owned and operated by Hydro One.

The Underground Distribution Standards are based upon, and comply with the CSA Standard C22.3 No.7-10 Underground Systems and as such they meet the safety requirements of Section 4 of Regulation 22/04.

Drawings and Specifications forming part of this Underground Distribution Standards are as per the attached list.

Hydro One does not assume any responsibility for the application of these Standards by anyone other than staff of Hydro One or its contractors and Subdivision Developers.



Michael Power P.Eng.

Chief Engineer & Director
Project Development
Engineering & Project Delivery
Hydro One Networks Inc

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SECTION 1
DEFINITIONS

SECTION 2
USER GUIDE

Section 1
Definitions

Definitions

Approved Standards - means this book, including text and drawings, and other published interpretations, amendments or additions, approved by Hydro One for that purpose.

Contractor/Constructor - firm of contractors, the company, or the individual acting as contractor and commissioned by the subdivision developer to install the Primary Distribution System and Secondary Distribution System in the subdivision.

Design Engineer - A Professional Engineer designated by Hydro One to approve the design drawings.

Distribution Planner- A Hydro One staff responsible for planning of distribution system and specifying its associated facilities such as cables, transformers, kiosk, switchgear etc.

Inspector - A Hydro One employee who has been assigned to inspect the contractor's work and method of installation in accordance with the specifications for that project and the *approved standards*.

Interim-Standard - An approved design or installation that occurs repetitively but was not previously included in the published consolidated Standards book. Such Interim Standard has the potential of being included in the next revision of the Standards book.

Kiosk - A pad-mounted type enclosure (also known as Sectionalizing Enclosure) with insulated junction(s) for installing 200A elbows, for up to 27.6 kV rated systems. A kiosk can be single phase or three phase, it can typically have 3 or more ways, and it is intended to sectionalize or tap a circuit. For circuits rated up to 25 kV, the Kiosk can be used as a loadbreak device, through the operation of loadbreak elbows. It does not contain any switches.

Non-Standard - Any design or installation that does not conform to *approved standards*. Typical or common variations from the *approved standards* are still considered to be *non-standard* and require specific case-by-case approvals. Non-Standard design can be a project specific (once –off) or it can become an Interim Standard, if it has potential of being used repetitively.

Ontario Electrical Safety Code - is the code that comprises the Canadian Electrical Code together with specific Ontario amendments to establish safety standards for the installation and maintenance of electrical equipment.

Standard Material Database - A database containing Hydro One approved materials. Each material item is identified with a specific Material Master Number (MM#) For more information on the material referred to in this standard, see section 16.

Switchgear - A pad-mounted type enclosure with loadbreak switches rated up to 600 A and 27.6 kV. It may be single phase or three phase type and has typically 3 or more ways. The switches may also have fault interrupting capability. Switchgear is intended to sectionalize or tap a circuit. For circuits rated up to 27.6 kV, the switchgear can be used as a loadbreak device, through the operation of switches.

Section 2
User Guide

Overview

The Underground Distribution Standards are the standards approved by Hydro One for the construction of underground distribution systems, operating below 44 kV.

These Standards are prepared to ensure that the Hydro One owned underground distribution systems, when designed and constructed as per these Standards, will satisfy the requirements of CSA Standard C22.3 No.7, Underground Systems, and also meet Hydro One requirements.

These Standards also contain design and application guides which are intended to assist the designers with typical application criteria.

Wherever necessary, the sections in the Standards are divided into two main subsections; 1) Design, and 2) Construction. Suffix letter "D" follows the design subsection numbers and suffix letter "C" follows the construction subsection numbers.

General Rules

Installations that do not conform to these Standards require the approval of a Hydro One Design Engineer. All approved deviations shall, as a minimum, meet the requirements of CSA Standard C22.3 No. 7. All customer owned equipment and installations shall comply with the Ontario Electrical Safety Code.

Methods

This book does not describe the "how" of doing work. These techniques are covered in the various Hydro One "Work Methods" documents.

SECTION 3
SINGLE PHASE DISTRIBUTION
(RESIDENTIAL SUBDIVISIONS)

Section 3
Single-Phase Distribution - Residential Subdivisions

In this Section

This Section outlines the design and construction standards for specifying and installing typical single-phase underground distribution network, operating at single phase primary voltages up to 16 kV, in residential subdivisions. This Section is divided into two main sub-sections.

Sub-section 3D covers design related matters and sub-section 3C covers construction related matters.

Topic	Section #	Rev Date
Design Guide - Single Phase Distribution, Residential Subdivisions	3D	Nov 2011
Construction Guide - Single Phase Distribution, Residential Subdivisions	3C	Nov 2011

SUB-SECTION 3C
CONSTRUCTION GUIDE
SINGLE PHASE DISTRIBUTION

Sub-Section 3C
Construction Guide
Single-Phase Distribution

In this Section

This Section details the construction related requirements for the installation of underground distribution system in single-phase residential subdivisions.

This Section is divided into Sub-sections as follows:

Topic	Sub-Section #	Rev Date
General	3C-1	Nov 2011
Civil Construction & Cable Installation	3C-2	Nov 2011
Single-Phase Pad Mounted Transformers	3C-3	Nov 2011
Single-Phase Primary Switching Equipment- Kiosks and Switchgear	3C-4	Nov 2011
Equipment Primary Terminations and Labeling	3C-5	Nov 2011
Transformer Secondary Terminations and Labeling	3C-6	Nov 2011

SUB-SECTION 3C-1
GENERAL

Sub-Section 3C-1
General

Scope

This section applies to the installation of standard, underground distribution system that:

- typically serve residential subdivisions; and
- will be owned by Hydro One Networks Inc (Hydro One).

This section does NOT address installations for unique residential distribution system that must accommodate special circumstances such as combination of residential and commercial subdivisions. The installation of these special situations shall be discussed with, and approved by, Hydro One.

Purpose

The purpose of this section is to provide direction and support to:

- Subdivision Developers and Constructors for the construction of residential underground subdivisions; and
- Subdivision Inspectors for the inspections conducted to ensure compliance with these Standards.

This construction guide is prepared to ensure that:

- the underground distribution system, to be owned by Hydro One, is constructed on a consistent basis; and
- only materials that are approved by Hydro One are used for the construction of such underground distribution system.

General Rules

Underground distribution system, to be owned by Hydro One, shall be installed as per the Hydro One approved design and layout drawings, and shall comply with these Standards. Any deviation from these Standards shall be submitted to, and be approved by, Hydro One prior to construction.

If the subdivision developer retains the services of a contractor to construct any portion of the power supply network, then Hydro One retains the right to provide an inspector, at developer's/contractor's cost, to inspect the work being performed.

All customer-owned equipment and installations shall comply with the Ontario Electrical Safety Code.

Safety

All construction shall be carried out with adequate safeguards to minimize the risk to the public, the workers, and existing structures. All applicable construction safety rules of Hydro One, OH&SA, local Municipalities, and other concerned agencies shall be followed.

As Built Drawings

Upon completion of construction, signed and red-lined "as-built" drawings must be submitted to Hydro One.

SUB-SECTION 3C-2
CIVIL CONSTRUCTION & CABLE INSTALLATION

Sub-Section 3C-2
Civil Construction & Cable Installation

General

This section details the standards for location of facilities, trenching, backfilling, cable laying, foundation installation, and grounding of electrical equipment.

Trench and Foundation Location

The centerline of primary cable trenches shall run parallel to the street property line, and be as specified on project specific subdivision design drawings or based on the typical utility service locations as outlined in drawing DU-03-201. Utility service locations are specific to each locality, and the concerned Municipality Standards will supersede Hydro One typical drawings. The Municipality Standards must, as a minimum, comply with CSA Standard C22.3 No 7 -Underground Systems. Any deviation from Hydro One Standards, or project specific subdivision design drawings, must be referred to Hydro One for approval.

Equipment foundations shall be located within the ROW as per local Municipal Standards, and based on the drawing DU-03-201. See DU-03-210 for a typical foundation installation.

Foundations shall be:

- centered on the common lot line projection unless otherwise noted on the drawing.
- preferably oriented to enable the access hood/door to be opened from the street side for operation/maintenance.

  Where 3 m operating clearances are assured, the equipment hood/doors can be oriented at 90 degrees to the street direction, so that Lines staff can view the equipment location number and FCI indication (for LED type FCI) through the front windshield glass of their vehicle, while driving along the street.

  The equipment orientation shall be indicated on the layout drawings.

Equipment located on roads with an “open ditch” profile shall be installed in accordance with drawing DU-03-204.

Underground cables and pad-mounted equipment foundations are to be located sufficiently far from future structures so as not to be disturbed when basements and foundations are excavated.

Common (Joint) Utility Trenching

Prior to starting the excavation, the common trenching installations shall be coordinated by the Subdivision Developer with all utilities, including Hydro One, Telephone utility, Gas utility, and the local CATV company.

Typical power, gas pipeline and communications cable relative locations and separations are shown on drawings DU-03-205, DU-03-205.1, DU-03-206 and DU-03-206.1. Location of various utility cables and pipelines near foundations are shown on drawings DU-03-204.1 and DU-03-204.2.

Communication cables may be installed in the same vertical plane as secondary cables, with 300 mm minimum clear vertical separation. However, communication cables must have a minimum of 300 mm horizontal and vertical separation from primary cables.

Power cables must not run in the same vertical plane as gas pipelines.

Gas pipelines shall have a minimum horizontal separation of 300 mm (preferred 600 mm) from any part of Hydro One equipment ground grid.

Trenching

Trenches shall be dug as true to line as possible and the bottom of the trench shall be uniform and raked free of stones and all other foreign and sharp materials. A layer of clean mason sand, as specified on drawings, shall be placed prior to installation of cables. In all cases, trenches shall be of adequate depth and width to accommodate cables with specified separations, as shown on drawings DU-03-205 thru DU-03-209. All distances for trench locations shall be from the centerline of the trench to a property line or curb.

Crossing Other Utilities

Where it is necessary for one underground system to cross over or under another underground system, the crossing shall be made at right angle, or as nearly so as circumstances will permit.

For power cables crossing a gas pipeline, a minimum of 300 mm clear vertical separation of well compacted fill must be maintained. For details see DU-03-208. If this separation is not possible, then the power cable shall be in duct, which extends at least 600 mm on either side of the gas line. Approval of both utilities shall be obtained for this.

For power cables crossing high pressure pipelines, specific approvals are required from the pipeline owning authority.

Laying Direct Buried Cables

Primary and Secondary cables shall be installed as per the drawings in these Standards. Cables shall be laid in such a manner that, during installation, they shall not be damaged in any way and in no case shall one cable cross over another in such a manner that it will bear directly upon the lower cable.

Cables shall be laid directly in the trench from the reel and not pulled by any mechanical means. Where this is not possible, the cables are to be walked in by hand. Care shall be taken not to damage the cable in any way during the cable laying operation. The cable bending radius shall be not less than 10 times the cable diameter (350 mm for 28kV 2/0 cable).

Street Crossings

All primary and secondary cables in road crossings shall be installed, in 100 mm diameter type DB2 PVC ducts, as per DU-03-207 or in HDPE ducts per DU-03-207.1.

The center line of primary and secondary cable street crossings at locations other than intersections shall extend, perpendicular to the curb, to the opposite side of the street, and preferably be:

- located at the center of the equipment foundation, or
- determined by a line starting 3 m to the right or left of the equipment foundation.

All ducts shall extend a minimum of 1 m beyond the back of curb/ditch on both sides of the roadway, and shall not extend into the longitudinal trench. Ducts located at the center of the equipment foundation shall connect to the knockouts in the foundation.

Cables shall be installed in ducts, with maximum of one primary cable per duct or two secondary triplex cables per duct.

For all road crossings, a spare duct shall be installed at each crossing location, and be complete with a polypropylene rope of 7 mm diameter or equivalent for cable pulling. The duct shall be capped at both ends. Where there is a primary and secondary cable crossing at the same location, there should be a spare duct for each. An additional spare duct per express/tap primary feeder cable is also required.

Trench excavation and boring for road crossing ducts shall be of sufficient width to accommodate all ducts as per DU-03-207.

In rocky ground, ducts shall be placed within an envelop of clean mason sand, extending 75 mm above, below and to the sides of the ducts, and then back-filled with clean native material as per DU-03-207.

The Municipality Standards will determine the requirements for backfill and patches required for street crossings. In some areas “unshrinkable fill” may be required.

Granular material used for road base backfill and native backfill shall be placed in layers of 150 mm maximum in depth, and each layer compacted to a minimum of 95% of Standard Proctor Dry Density, unless otherwise specified by the Municipality.

Duct Banks

All ducts shall be set on undisturbed or well-compacted soil. Ducts shall be 100 mm diameter, PVC type DB2.

Bends in ducts shall employ “large radius” components of at least 600 mm radius (minimum 6 x duct diameter).

Ducts in concrete encased duct banks shall be supported by spacers, and properly secured to prevent them from floating in liquid concrete.

All multiple lengths of ducts shall be properly cemented together with a chemical bond type PVC adhesive.

Where ducts are installed and cables are to be pulled at a later time, a polypropylene rope of 7 mm diameter (or equivalent) shall be installed in all ducts, from end to end. Both ends of ducts shall be capped. To facilitate locating these ducts in future, such duct locations shall be marked by above ground wooden stakes, embedded 600 mm in the ground, at both ends of the ducts.

Horizontal Directional Drilling (HDD)

At times, the Municipality or other authorities may not allow open cut trenching on major roads, highways, railways and street crossings. At such times, HDD technique can be used in place of open cut trenching. HDD is a trenchless technology. HDD has several advantages such as faster installation and less construction time, lower cost of surface restoration, less disruption to traffic and public etc.

While carrying out HDD for cable installations, the following should be observed.

- Approval of the respective authority must be obtained for the HDD and the material used there in.
- The ducts shall conform to NEMA TC-7 EPEC-B type. Ducts should be minimum 100 mm (4") diameter, HDPE. Minimum thickness shall correspond to SDR13.5. SDR number selected must be such that the duct can withstand the expected pulling and other forces during the duct installation and also subsequent to its installation (other forces include but not limited to pressure of drilling slurry, external pressure due to earth pressure.)
    - Note: Railways may require use of overall steel casing pipe over HDPE ducts.
- Duct colour shall be black or grey
- At least one spare duct shall be installed.
- Steel casing pipe must not be used to cross a single phase cable. It must contain three phase circuit(s).
- Sometimes HDPE ducts fused together at site are also used for longer crossings. Such ducts shall be fused using manufacturer's instructions and proper fusing equipment.
- Environmentally friendly Bentonite clay slurry shall be used as backfill and drilling mud during HDD operation. Sufficient slurry shall be used to fill all voids and prevent sinking of the road surface.
- The directional bore should be controllable and it should be possible to accurately steer the drill head in the desired direction. Damage to other utilities must be avoided.
- While pulling the cables through HDD ducts, the allowable cable pulling tensions shall not exceed the limits specified in section 13-2. The cable or duct is usually pulled through from the side of the crossing opposite of the drill rig location.

Drawing DU-03-207.1 shows typical details of cable installation with HDD technique.

Cable Pulling Tensions

While pulling cables, the cable manufacturer recommended maximum-pulling tensions and sidewall pressures for the type and size of the cable being pulled, shall not be exceeded. See Section 13-2 for suggested limits.

Patio Slabs

Patio slabs, when used for mechanical protection, shall extend at least 50 mm beyond the sides of cables or ducts, and shall be buffered from the cables or ducts by a 150 mm thick layer of compacted clean mason sand. Patio slabs shall be of minimum 50 mm thickness.

Backfill

A bed of clean mason sand, raked and compacted, shall be placed in the trench bottom before installation of direct buried cables and ducts. Top and sides of cables shall also be surrounded by raked and compacted clean mason sand. For trenching during frost, an additional 150 mm thick layer of clean mason sand shall be provided above cable or duct, and the backfill shall be free of lumps of ice.

The backfill material (mentioned as mason sand in this Standard) shall meet the following specifications

1. Shall be obtained by crushing of sound rock commonly known as "stone screenings" or " crusher fines"
2. Material produced from shale or other rock showing undesirable disintegration will not be accepted
3. Preferred dry density is not less than 1800 kg/m^3
4. The material shall meet the following sieve analysis.

Sieve Size No.	Per Cent Passing
4	100
10	65-100
20	35-55
60	15-30
140	10-18
200	8-14

In rocky ground, and in trenches with sharp stones, a bed of clean mason sand or clean native backfill (without stones and sharp objects), raked and compacted, shall be placed in the trench bottom before installation of direct buried ducts. The top of the direct buried ducts shall be covered with clean mason sand, or clean native backfill (without stones and sharp objects).

Trenches shall be back-filled with clean native backfill in layers not exceeding 150 mm, and each layer thoroughly compacted to a minimum of 95% Standard Proctor Dry Density.

Backfill(cont.)	The clean mason sand and native backfill as shown on drawings, that immediately surrounds the cable/duct shall be put in place using hand shovels. Mechanical equipment may be used to backfill the balance of the trench using normal clean native backfill. For details of direct buried cable trench and direct buried duct trench, refer to DU-03-205, DU-03-205.1, DU-03-206, DU-03-206.1, DU-03-207 and DU-03-209.
Caution Tape	Power cable marking caution tape, covering all the cables/ducts in the trench, shall be buried approximately halfway between the uppermost cable/duct and the grade level. Tape is not necessary over concrete encased duct banks.
Restoration of Surfaces	All surfaces that are disturbed, due to digging and equipment foundation installation, shall be reinstated to their original condition or better, as determined by the Municipality. All grass and vegetation areas are to be restored by placing 100 mm of approved top soil and nursery sod, unless noted otherwise by the Municipality.
Cable Route Markers	Cable route markers are normally not required when underground cables are located along the ROW. For underground cables located in unusual locations, including parks and greenbelts, or built into bridges or other structures, cable route markers (as specified by Hydro One), shall be installed at 20 m intervals and at changes in the cable route directions.
Primary Cable Splices	Every effort shall be made to avoid splices on primary cables. Primary splices other than those shown on the subdivision design drawings, are to be approved by a Hydro One Design Engineer. The location of splices must be accurately identified on the "as-built" drawings, and the location shall be indicated with an at grade cable route marker, installed at a 600 mm offset from the edge of the outermost cable. See DU-03-205 for typical location of cable route marker.
Primary Cable Riser/Dip Poles	Temporary cable loops shall be tied on the riser/dip pole with enough cable length to reach overhead lines to which the cable is to be connected. The cable termination and connection to the line shall be done by Hydro One. For details see DU-03-213.

Secondary Services

Secondary service cables and trenches shall be installed in accordance with drawings DU-03-202 and DU-03-209. The cables shall be identified at both ends, as to the lot number they serve, and the municipal (911) address if available, as shown on DU-03-602. The Subdivision Constructor is responsible for the temporary but clear markings at both ends of the cables. The final markings and labeling will be done by Hydro One.

When left exposed in transformers, at poles, vaults, or service locations, the cable ends shall be adequately protected (i.e. taped and bagged).

Where possible, secondary service cables shall run directly from transformers to service entrances or meter bases. When this is not possible due to some reasons (e.g. the house wall being not ready), then the secondary service cable from transformer shall be terminated on a steel fence post or on a 50 x 100 mm nominal wood stake, located a minimum of 1 m inside the property line. The fence post or wood stake shall extend from bottom of the trench to a minimum of 1.0 m above existing grade. A length of polyethylene pipe shall cover the service cable length above grade, to provide temporary mechanical protection to the cable. The pipe shall extend from the trench bottom level to a minimum of 600 mm above grade and shall be securely attached to the fence post or wood stake. A minimum of 300 mm of service cable end shall extend outside the pipe end, and it shall be capped and bagged. For details see DU-03-209. Later on when the cable from the meter base to the property line is installed, it shall be spliced with the cable that was terminated on the stake. Prior to splicing, the end of the cable protruding outside the pipe shall be cut and discarded, and also the pipe shall be discarded.

In order to facilitate access for meter reading, the meters shall be located on the driveway side of the property, and therefore the service cables shall preferably run on the driveway side of the property. Services shall be placed in direct buried ducts from the street line to a point 1.2 m from the meter base. See DU-03-202 and DU-03-209.

At the transformer end of the secondary service cables, a minimum of 2 m length of each cable shall be left in the transformer vault for connection to the transformer secondary terminals. When the cables are to be terminated on the secondary terminal block or spade terminals, such terminals/blocks and the cables shall be capped and bagged until the such time as the terminations are done. The cables in the vault shall be tied together with plastic cable ties and then hanged from the ground clamp of the transformer, using plastic cable ties. The final cable connection to terminals or blocks shall be done by Hydro One.

Cable Testing

All spliced cable sections shall be megger tested as per HODS document TP 8017, and confirmed to have satisfactory insulation resistance.

Pad -Mounted Equipment Location and Foundations

The location of pad-mounted equipment foundations within the ROW shall conform to local Municipality Standards. Minimum clearances to other utility services and structures shall be maintained as per these Hydro One Standards. Equipment shall be located so that it will have the following minimum separations:

- 3 m from building structures.
- 6 m, line of sight, from window/door openings and any ventilation openings Transformers that are protected by an internal current-limiting (CL) fuse and are equipped with a pressure relief device (PRD) may be installed at 3 m or more (Most HONI transformers are provided with CL fuse and PRD).
- 3 m from driveway.
- 2 m (preferred) from roadway curb. Minimum shall be 1m.
- 300 mm from sidewalk.
- outside the 15 m sight line at corners of street intersections .
- 3 m from street light poles, fire hydrants, and trees.
- 150 mm for telephone, internet and cable TV distribution pedestals, and street light disconnect boxes.

The following operating and maintenance clearances shall be provided around pad-mounted equipment:

- 3 m on operating side of equipment, and
- 1 m on all other sides for working space.

Equipment foundation shall be installed in accordance with DU-03-210. Foundations shall be level, placed on a minimum 150 mm base of compacted granular “A”, and totally supported by undisturbed earth. Should the foundation installation require placement on sloping ground, Hydro One shall be contacted for specific remedial measures.

Cable openings in foundations shall be sealed by polyethylene seals (Poly Seals). Lifting holes in foundations shall be sealed using duct seal compound.

After installation of cables and equipment grounding, a minimum of 3 m of space, in front of the operating side(s) of the equipment and 1 m of space around other sides, must be backfilled, compacted and leveled to the proposed final grade level.

Equipment Grounding

Grounding of pad-mounted equipment shall consist of a minimum of four (4) 3/4" x 10' long galvanized steel rods, driven into the ground at a distance of 1 m from the equipment. The top of the ground rods shall be a minimum of 300 mm below finished grade level.

The ground conductor shall be a continuous #4 AWG stranded bare copper wire, and it shall:

- completely encircle the foundation, and be buried to a minimum of 300 mm below finished grade level; and
- be fastened securely to the ground rods with the ground rod connector. Each ground rod connector shall connect only one conductor to the rod.

A minimum of 2 m of each end of the ground conductor shall be left inside the equipment foundation for connection by Hydro One to the equipment. See DU-03-211 for typical equipment grounding arrangement.

Bollards for Equipment Protection

When specified by Hydro One, concrete filled, galvanized steel bollards, shall be installed as per drawing DU-03-212. The bollards shall be painted high-visibility yellow, and bonded to the pad-mounted equipment ground grid. The bonding conductor shall be a continuous #4 AWG stranded bare copper wire; "cad-welded" to the steel pipe and connected to the ground rod. Alternatively the wire can be connected to the steel pipe using an approved terminal compression connector; In this case paint on pipe at the point of connection of connector shall be removed, and a hole will have to be drilled through the pipe for connecting the compression connector.

Streetlight and Communication Equipment

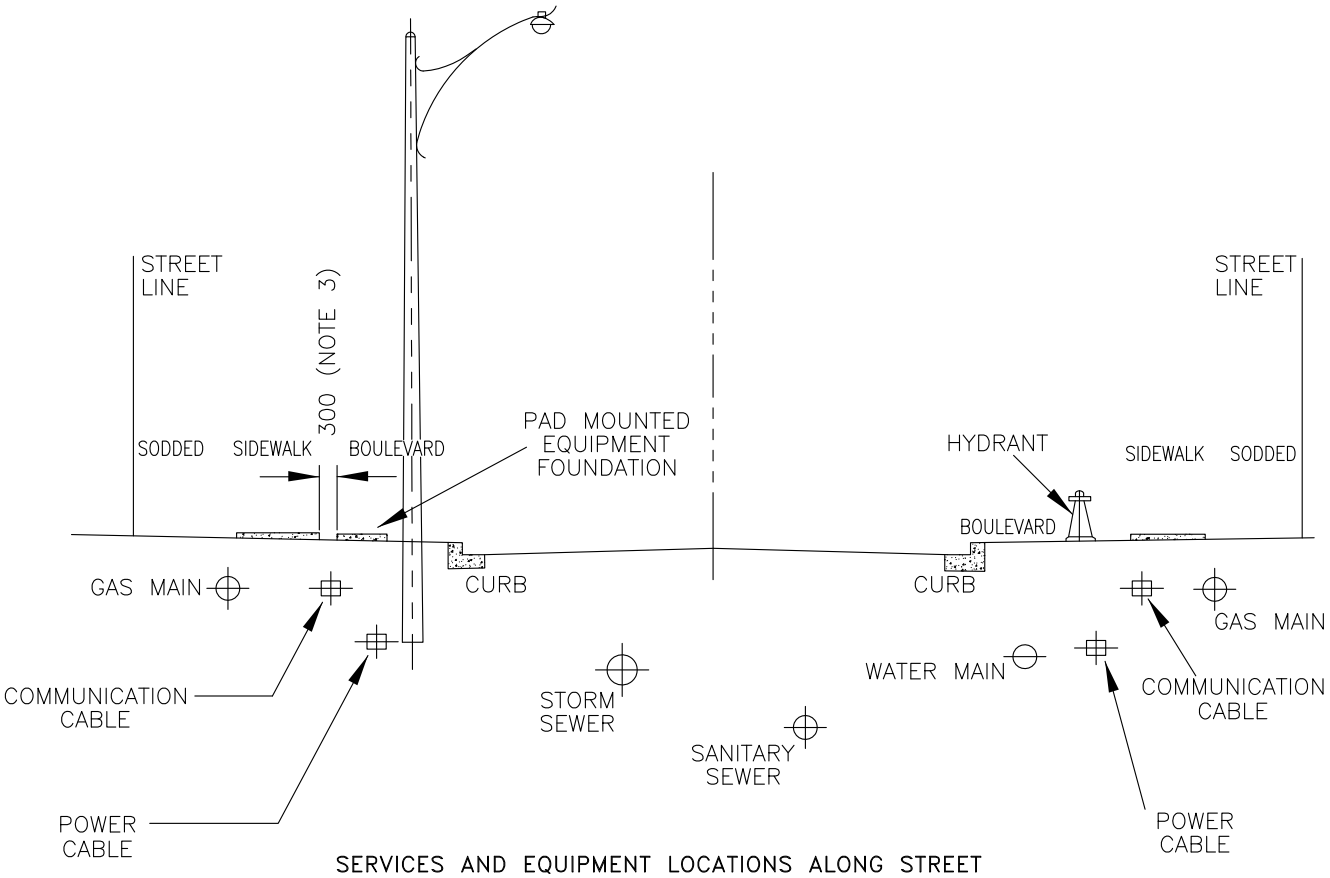
Streetlight systems are the responsibility of the Developer and as such shall be installed as per the Ontario Electrical Safety Code.

Streetlight disconnects and communication equipment pedestals shall not be directly attached to Hydro One pad-mounted equipment foundations. They shall maintain a 150 mm (minimum) separation as per Drawing DU-03-214. Metallic streetlight and communication equipment installed within 3 m of Hydro One pad-mounted equipment ground grid shall be bonded to the grid with a minimum #4 AWG bare copper wire, and approved connectors. Bonding connection shall be made on the ground rod.

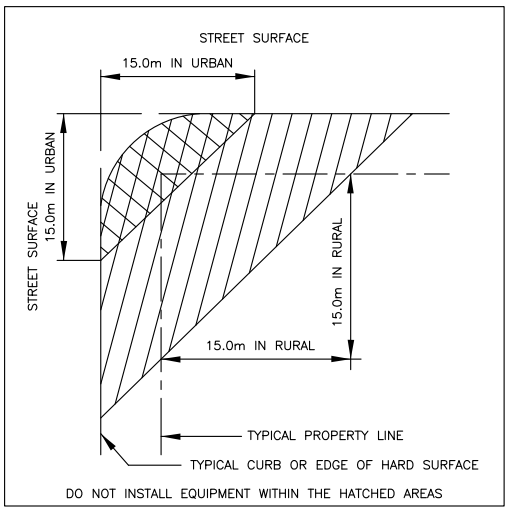
Hydro One shall make the final connection of street light and communication equipment power supply cables to Hydro One transformer.

In This Section This section contains the following drawings:

Description	Dwg. #	Rev.
Street Location of Various Services and Equipment - Typical	DU-03-201	R1
Layout of Service Cable Trench Within Lot Boundaries - Typical	DU-03-202	R2
Location of Equipment Foundation - Typical	DU-03-203	R2
Location of Equipment Foundation - Culvert System	DU-03-204	R1
3 Party Trench Detail of Cables at Foundation	DU-03-204.1	R1
4 Party Trench Detail of Cables at Foundation	DU-03-204.2	R1
Joint Trench - Power and Communication Cables -Typical	DU-03-205	R3
Joint Trench - Power and Communication Cables -Typical	DU-03-205.1	R2
Joint Trench - Power, Communication and Gas Distribution Lines - Typical	DU-03-206	R3
Joint Trench - Power, Communication and Gas Distribution Lines - Typical	DU-03-206.1	R2
Trench Utilities Crossing - Typical	DU-03-207	R3
Power Cables in Bundled HDPE conduit- Direction Bore Installation	DU-03-207.1	R1
Crossing Arrangement of Gas Pipeline, Communication & Power Cables - Typical	DU-03-208	R3
Trench Detail- Meter Base End of Secondary Service Cable- Typical	DU-03-209	R2
Equipment Foundation Installation	DU-03-210	R2
Pad-Mounted Equipment Grounding Details - Typical	DU-03-211	R3
Protective Bollards Installation	DU-03-212	R3
Temporary Termination of Underground Cable by Contractor For Future Connection to Hydro One Overhead Line	DU-03-213	R2
Streetlight Disconnect or Communication Cable Pedestal Near Hydro One Pad-Mounted Equipment	DU-03-214	R2



SERVICES AND EQUIPMENT LOCATIONS ALONG STREET



EQUIPMENT LOCATION NEAR STREET INTERSECTION

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. LOCATIONS SHOWN ARE TYPICAL ONLY. SPECIFIC LOCATIONS SHOULD BE DETERMINED LOCALLY.
3. LOCATE PAD MOUNTED EQUIPMENT FOUNDATION MINIMUM 300mm TO SIDEWALK. IF THE STREET HAS NO SIDEWALK, LOCATE IT AS FAR AWAY FROM THE TRAVELED PORTION OF THE ROAD AS POSSIBLE (ON THE ROAD ALLOWANCE) AS PERMITTED BY LOCAL STANDARDS.
4. A MINIMUM SEPARATION OF 1m SHALL BE MAINTAINED BETWEEN POWER CABLES & EXISTING OR PROPOSED TREES.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

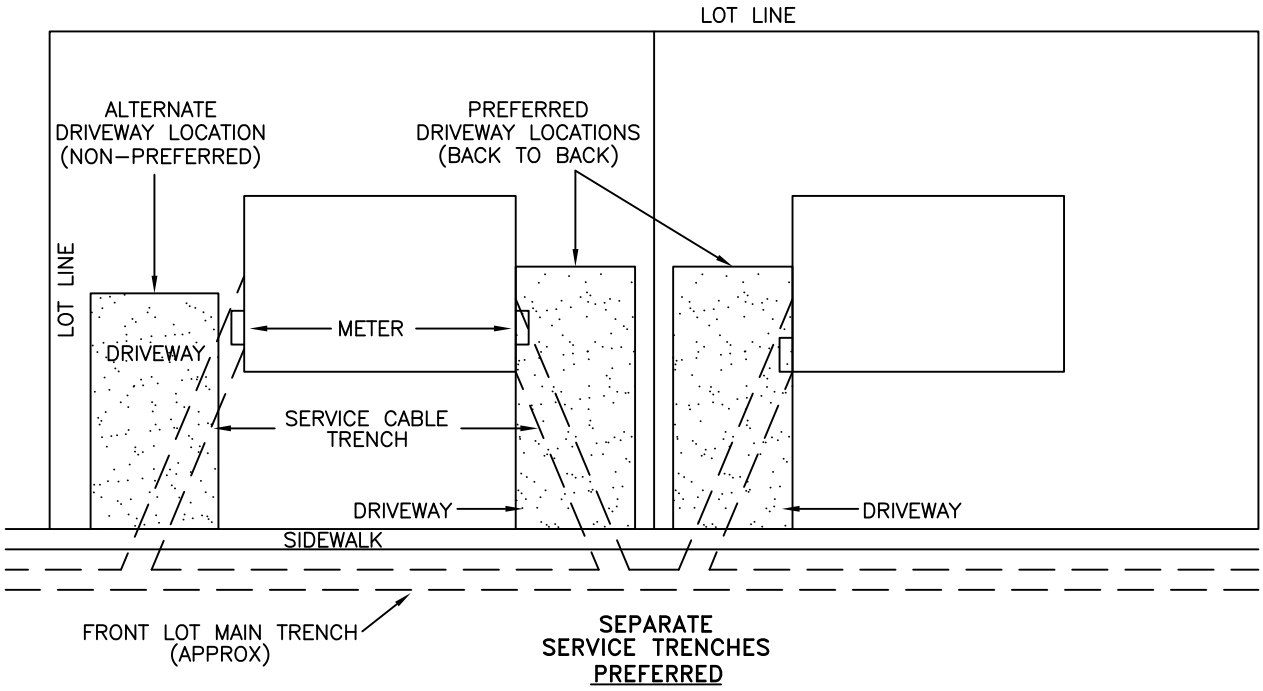
Rev. No.	Issue Date	Revision	Dwn	Approved By Date
02	MAR 2012	NOTE 4 REVISED *	* / *	* *

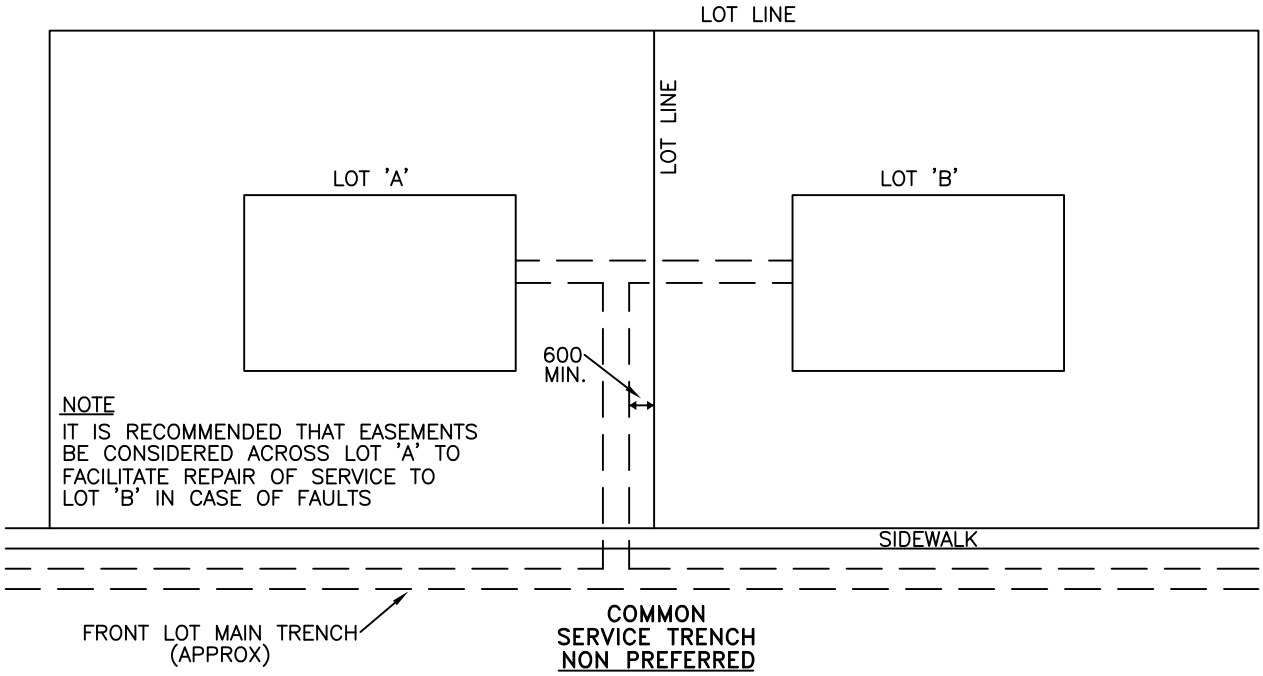
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A.McPHERSON	D.THOMPSON	JUNE 30, 2005

STREET LOCATION OF VARIOUS SERVICES & EQUIPMENT - TYPICAL

Dwg. No. DU-03-201 Rev. 02





NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. SERVICE CABLES ARE INSTALLED IN DUCTS.
3. LOCATION OF MAIN TRENCH IN RELATION TO CURB AND SIDEWALK TO BE DETERMINED FROM DWG. DU–03–201 OR BY LOCAL REGULATIONS.
4. METER LOCATION WILL BE AT HYDRO ONE DISCRETION AND ALSO MUST MEET ESA REQUIREMENTS.

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
02	NOV 2011	ADDED NOTE 4 *	SO / *	* *
01	SEP06 2006	GENERAL REVISIONS *	AM / DP	D.PARIKH 09/26/06

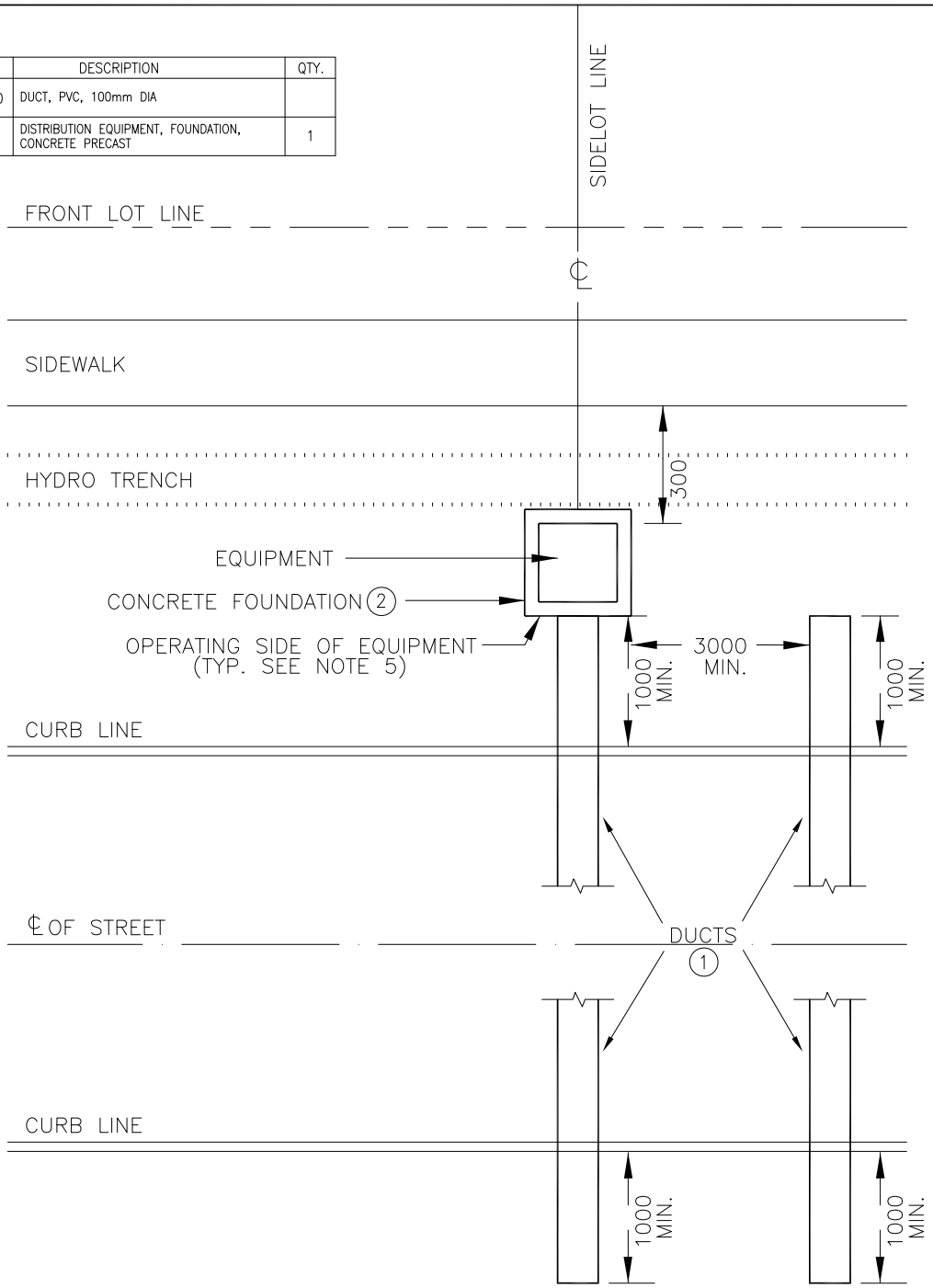
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A.McPHERSON	D.THOMPSON	NOV. 08, 2011

LAYOUT OF SERVICE CABLE TRENCH WITHIN LOT BOUNDARIES - TYPICAL

Dwg. No. DU-03-202 Rev. 02

PART #	MM #	DESCRIPTION	QTY.
①	30007710	DUCT, PVC, 100mm DIA	
②	*	DISTRIBUTION EQUIPMENT, FOUNDATION, CONCRETE PRECAST	1



NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. DETAILS OF EQUIPMENT FOUNDATION AND EQUIPMENT ELECTRICAL INSTALLATION WILL VARY, HENCE ONLY A FOUNDATION REFERENCE POINT IS NOTED HEREON.
3. LOCATION OF EQUIPMENT ALONG THE FRONT LOT LINE MAY VARY DUE TO DRIVEWAYS, AND OTHER OBSTRUCTIONS HENCE LOCATION NOTED ABOVE IS TYPICAL ONLY.
4. DUCTS SHALL NOT EXTEND INTO HYDRO TRENCH. DUCTS LOCATED AT EQUIPMENT FOUNDATION SHALL CONNECT TO KNOCKOUTS (IF AVAILABLE) IN THE FOUNDATION.
5. EQUIPMENT OPERATING SIDE CAN BE TURNED 90° IF 3.0m OPERATING CLEARANCE IS ASSURED.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

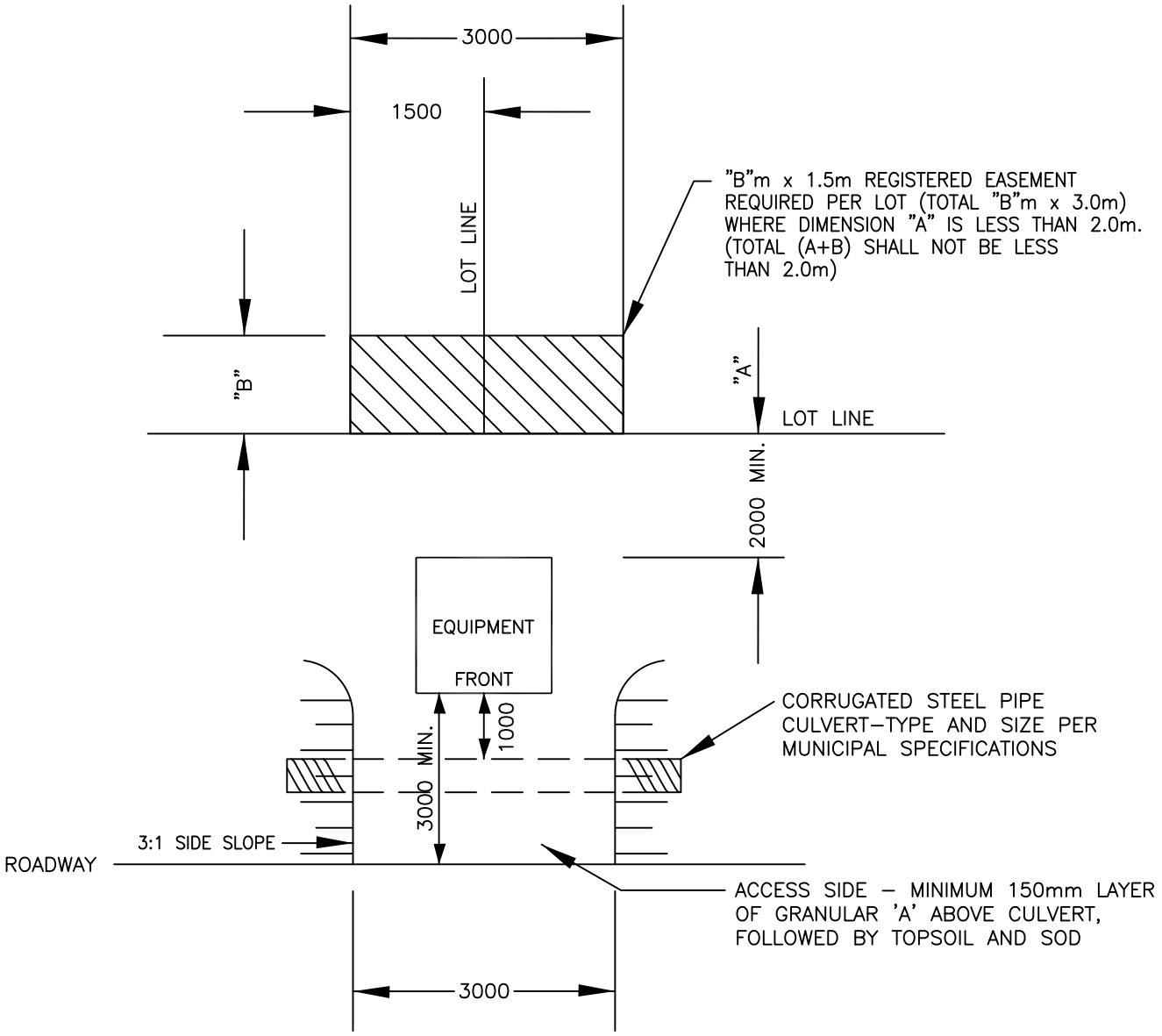
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
02	FEB 2011	MM# ADDED *	WB / PC	
01	SEP06 2006	GENERAL REVISIONS *	AM / DP	D.PARIKH 09/26/06

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	*	FEB. 17, 2011

LOCATION OF EQUIPMENT FOUNDATION - TYPICAL

Dwg. No. DU-03-203 Rev. 02



EASEMENT REQUIREMENTS AND EQUIPMENT ACCESS

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. FOR FOUNDATION INSTALLATION SEE DWG. DU–03–210.

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn	Approved By Date
01	SEP06 2006	GENERAL REVISIONS *	AM / DP	D.PARIKH 09/26/06

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A.McPHERSON	D.THOMPSON	JUNE 30, 2005

LOCATION OF EQUIPMENT FOUNDATION-CULVERT SYSTEM

Dwg. No. DU-03-204 Rev. 01

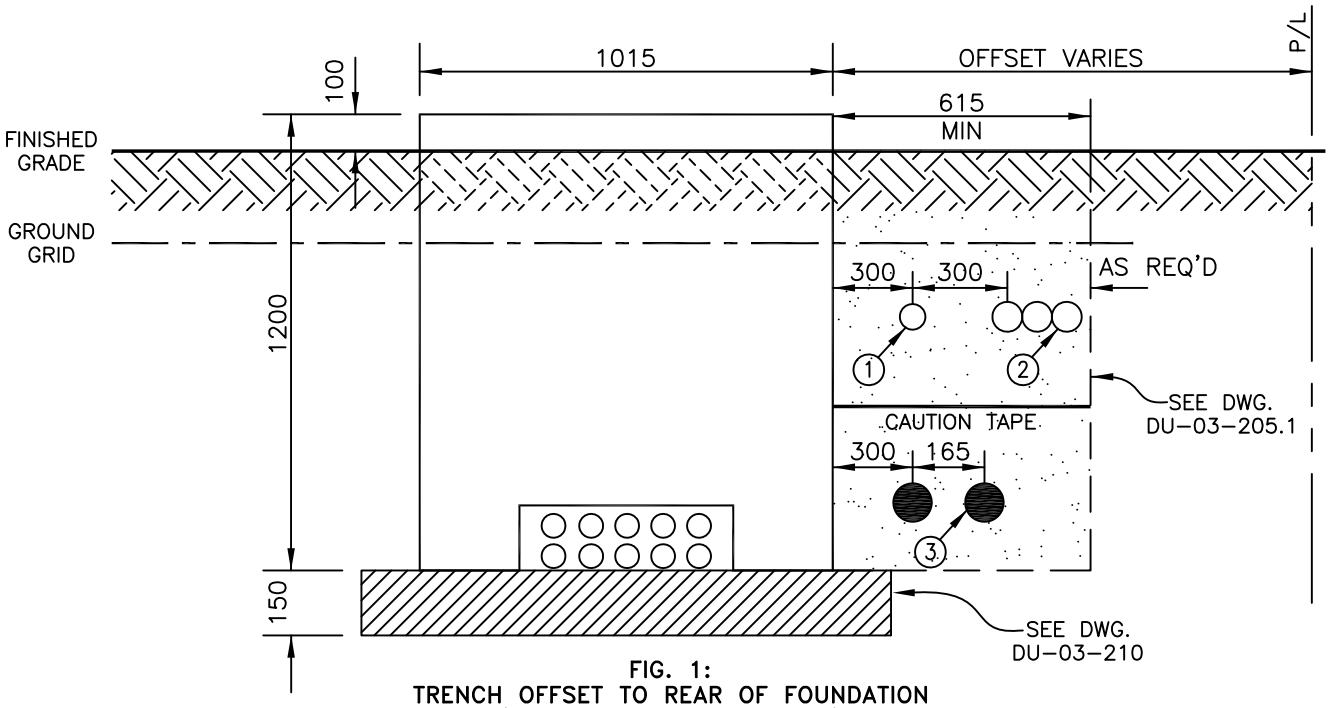


FIG. 1:
TRENCH OFFSET TO REAR OF FOUNDATION
(SIMILAR TO FRONT OFFSET)

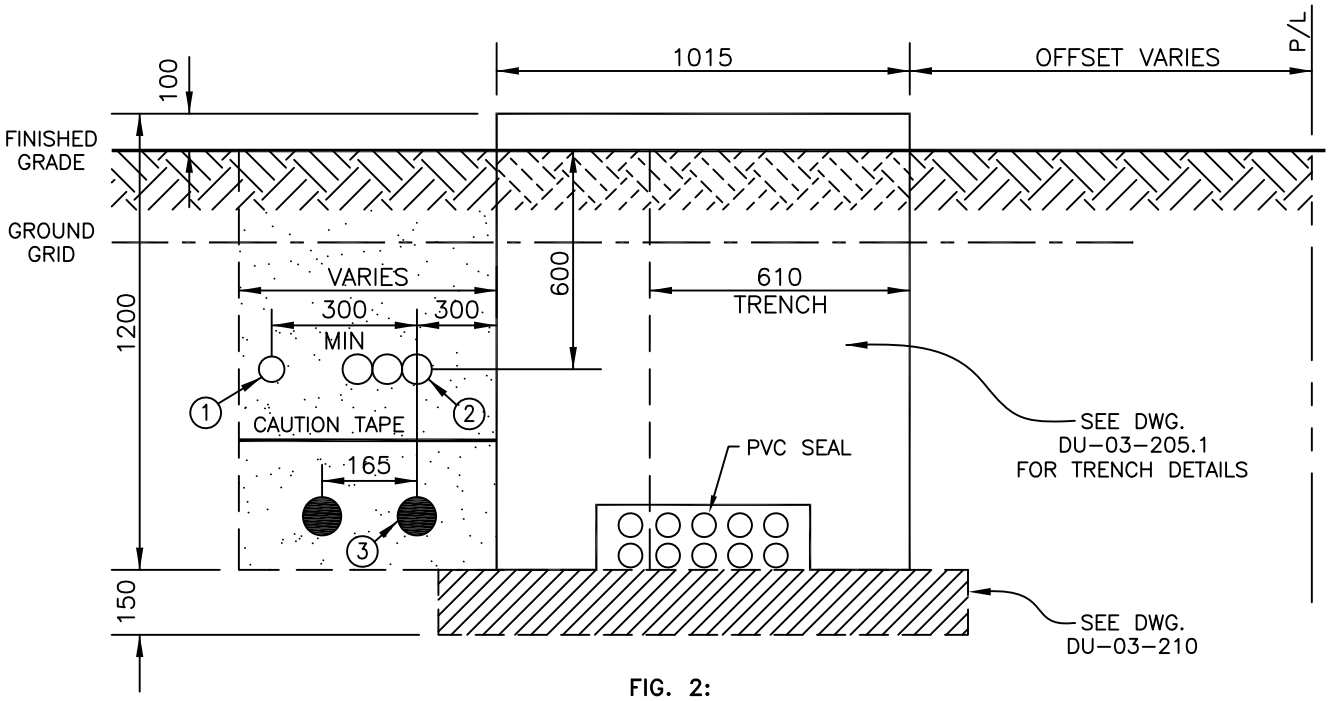


FIG. 2:
TRENCH AND FOUNDATION HAVING SAME OFFSET
(FOUNDATION STRADDLING TRENCH)

LEGEND:

1. STREETLIGHT WIRE IN DUCT
2. COMMUNICATION CABLES
3. PRIMARY CABLES

NOTE:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	* *	* *	*	*		*
01	NOV 2011	PVC SEALS SHOWN CHANGED FROM 190mm TO 165mm	SO	*		*

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
G.OKLECINSKI	*	NOV.08, 2011

3 PARTY TRENCH - DETAIL OF CABLES AT FOUNDATION

Dwg. No. DU-03-204.1 Rev. 01

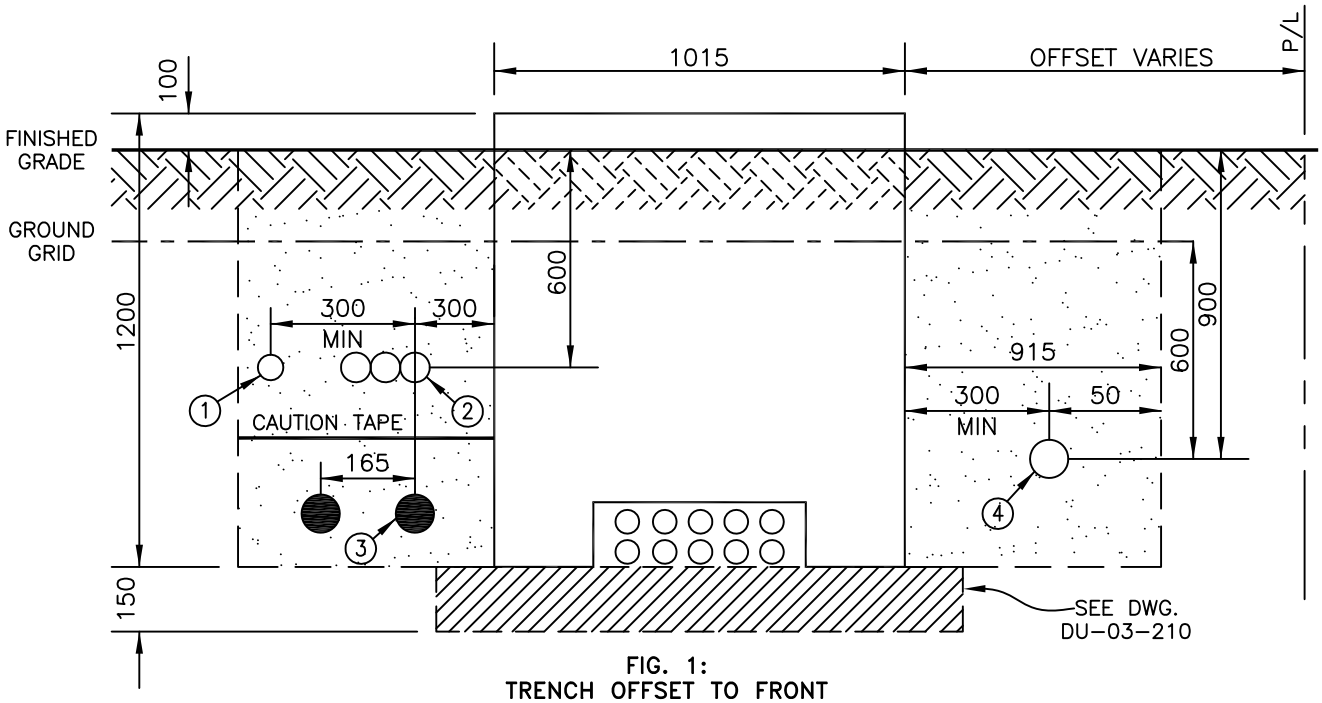


FIG. 1:
TRENCH OFFSET TO FRONT
OR REAR OF FOUNDATION

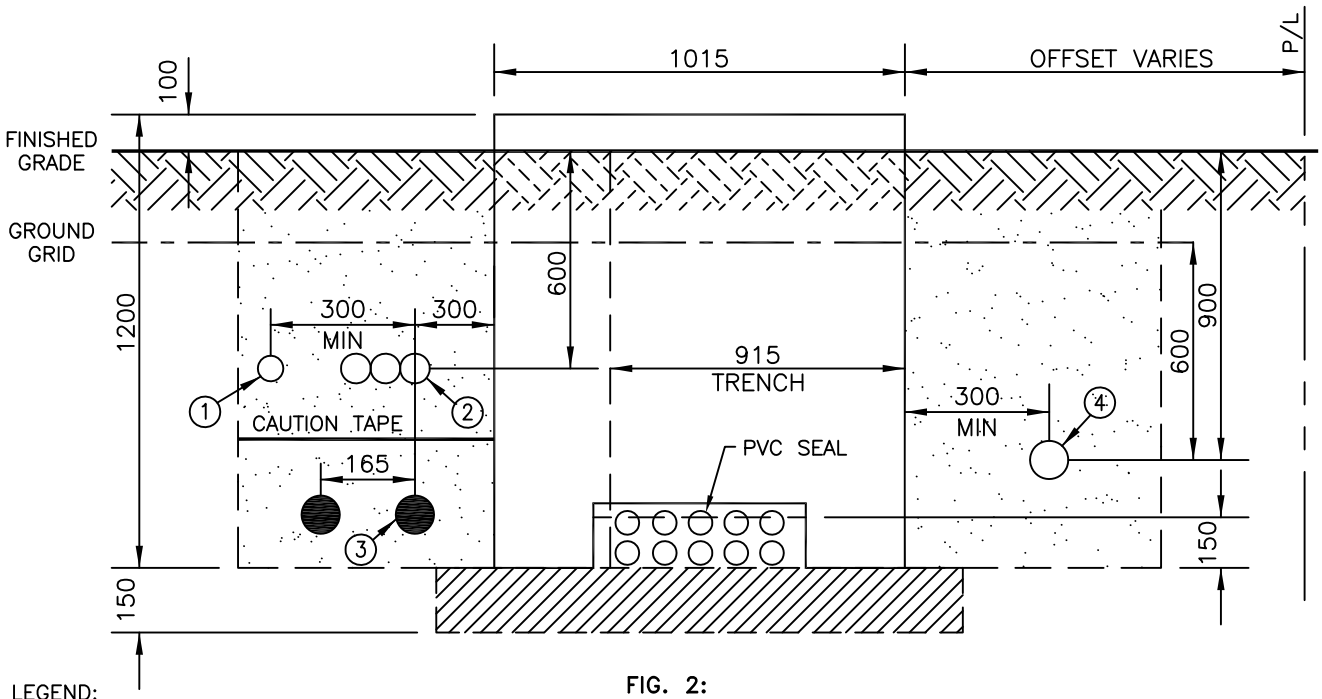


FIG. 2:
TRENCH AND FOUNDATION HAVING SAME OFFSET
(FOUNDATION STRADDLING TRENCH)

LEGEND:

(1) STREETLIGHT WIRE IN DUCT
(2) COMMUNICATION CABLES
(3) PRIMARY CABLES
(4) GAS PIPELINE

NOTE:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

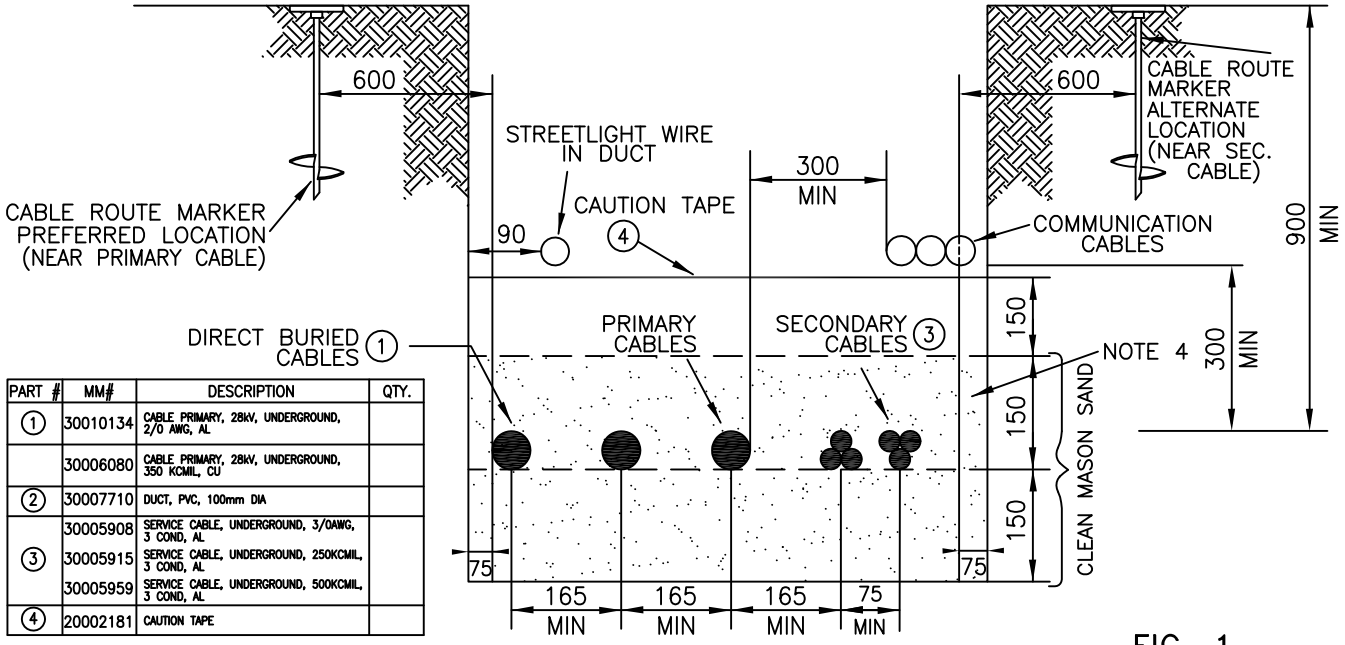
Rev. No.	Issue Date	Revision	Dwn	Approved By Date
*	* *	* *	*	*
01	NOV 2011	PVC SEALS SHOWN CHANGED FROM 190mm TO 165mm	SO	*

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
G.OKLECINSKI	*	NOV.08, 2011

4 PARTY TRENCH - DETAIL OF CABLES AT FOUNDATION

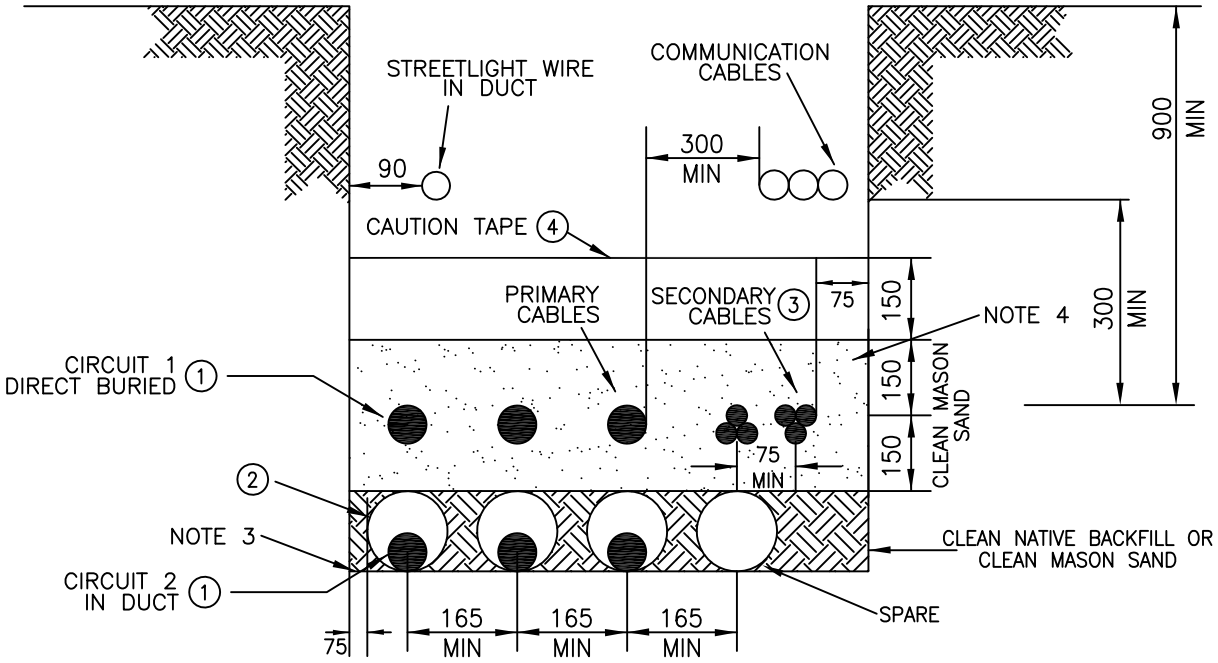
Dwg. No. DU-03-204.2 Rev. 01



PART #	MM#	DESCRIPTION	QTY.
1	30010134	CABLE PRIMARY, 28kV, UNDERGROUND, 2/0 AWG, AL	
	30006080	CABLE PRIMARY, 28kV, UNDERGROUND, 350 KCMIL, CU	
2	30007710	DUCT, PVC, 100mm DIA	
3	30005908	SERVICE CABLE, UNDERGROUND, 3/0AWG, 3 COND, AL	
	30005915	SERVICE CABLE, UNDERGROUND, 250KCMIL, 3 COND, AL	
	30005959	SERVICE CABLE, UNDERGROUND, 500KCMIL, 3 COND, AL	
4	20002181	CAUTION TAPE	

SINGLE PRIMARY CIRCUIT

FIG. 1



ALTERNATE SUPPLY CABLES IN SAME TRENCH AS MAIN SUPPLY CABLES (NOT PREFERRED)

FIG. 2

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. ALL SEPARATIONS AND DEPTHS OF BURIAL ARE MINIMUM.
3. IF TRENCH BOTTOM IS NOT LEVELED, AND FREE OF STONES & SHARP OBJECTS, THEN A 75mm THICK LAYER OF COMPACTED, CLEAN NATIVE BACKFILL OR CLEAN MASON SAND SHALL BE PLACED IN THE TRENCH BOTTOM BEFORE INSTALLING DUCTS.
4. FOR TRENCHING DURING FROST, THE SAND COVER SHALL BE 300mm, AND THE BACKFILL SHALL NOT CONTAIN ANY LUMPS OF ICE.

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn	Approved By	Date
03	NOV 2011	ADDED MM# & SPARE DUCT, REVISED 190mm TO 165mm	SO *		
02	OCT 2009	ADDED STREETLIGHT DUCT LOCATION	PC *	*	*

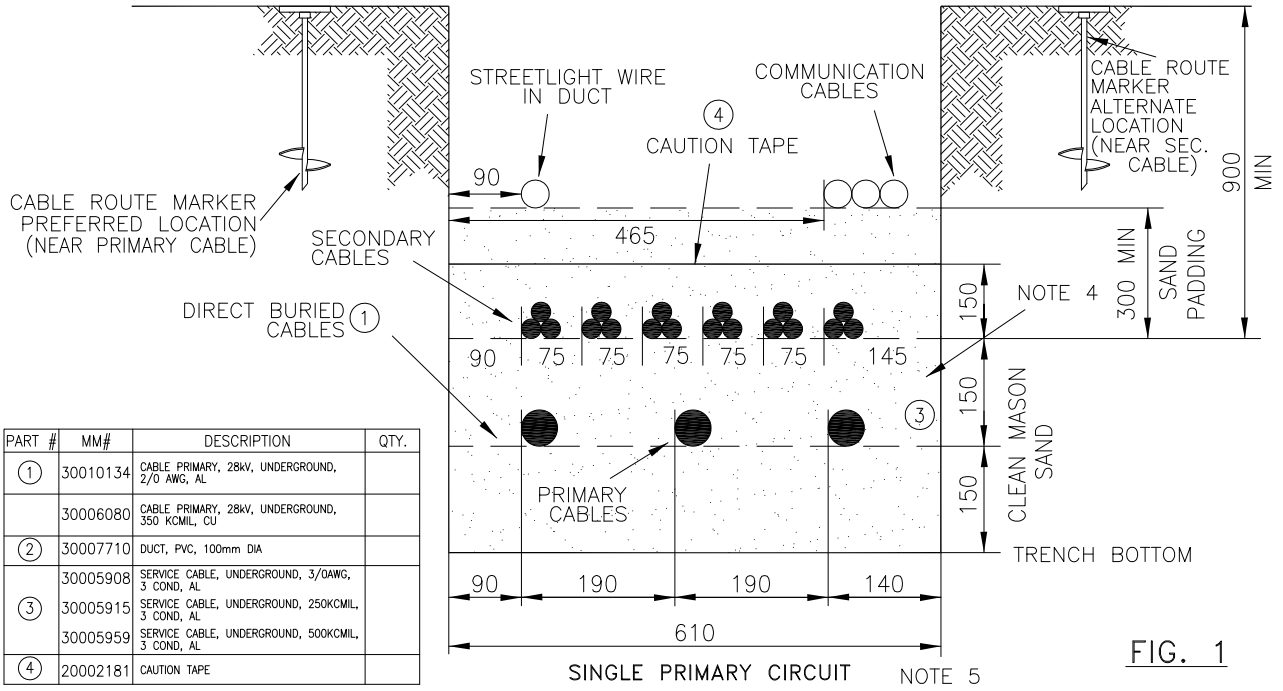
hydro one

Hydro One Networks Inc.

Drawn:	Approved:	Date:
M. CRONIN	*	NOV. 15, 2011

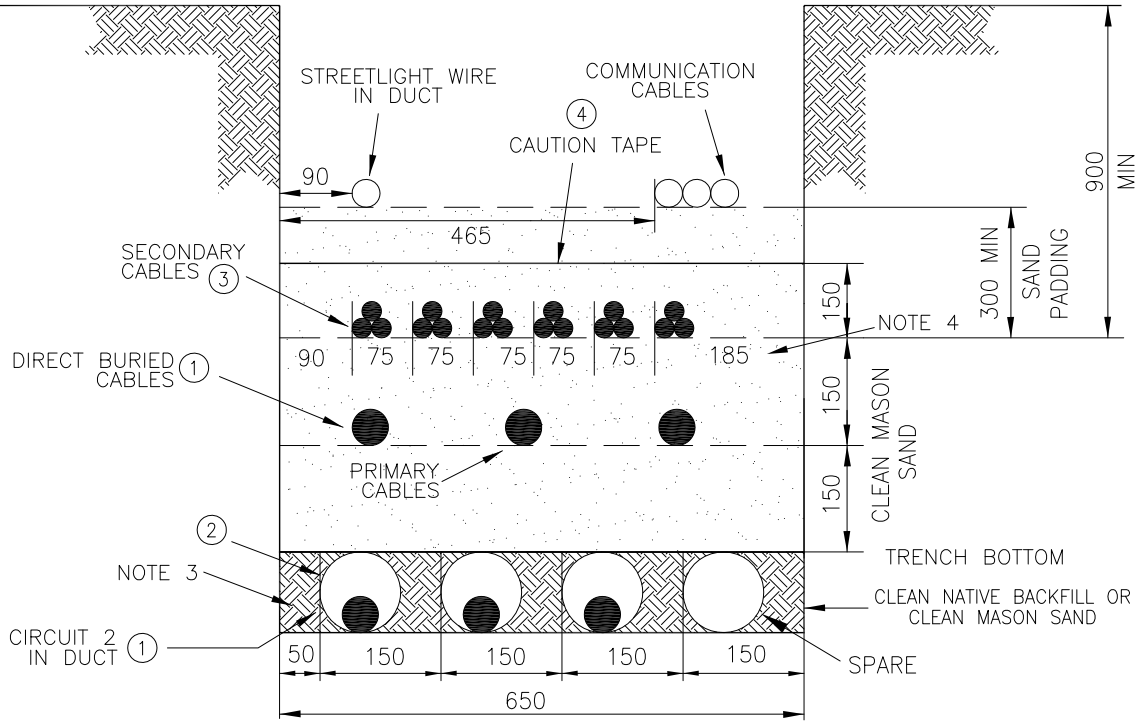
JOINT TRENCH - POWER & COMMUNICATION CABLES - TYPICAL

Dwg. No. DU-03-205 Rev. 03



PART #	MM#	DESCRIPTION	QTY.
1	30010134	CABLE PRIMARY, 28kV, UNDERGROUND, 2/0 AWG, AL	
	30006080	CABLE PRIMARY, 28kV, UNDERGROUND, 350 KCMIL, CU	
2	30007710	DUCT, PVC, 100mm DIA	
3	30005908	SERVICE CABLE, UNDERGROUND, 3/0AWG, 3 COND, AL	
	30005915	SERVICE CABLE, UNDERGROUND, 250KCMIL, 3 COND, AL	
	30005959	SERVICE CABLE, UNDERGROUND, 500KCMIL, 3 COND, AL	
4	20002181	CAUTION TAPE	

FIG. 1



ALTERNATE SUPPLY CABLES IN SAME TRENCH AS MAIN SUPPLY CABLES (NOT PREFERRED)

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. ALL SEPARATIONS AND DEPTHS OF BURIAL ARE MINIMUM.
3. IF TRENCH BOTTOM IS NOT LEVELED, AND FREE OF STONES & SHARP OBJECTS, THEN A 75mm THICK LAYER OF COMPACTED, CLEAN NATIVE BACKFILL OR CLEAN MASON SAND SHALL BE PLACED IN THE TRENCH BOTTOM BEFORE INSTALLING DUCTS.
4. FOR TRENCHING DURING FROST, THE SAND COVER SHALL BE 300mm, AND THE BACKFILL SHALL NOT CONTAIN ANY LUMPS OF ICE.
5. FOR ADDITIONAL CIRCUITS (IE. EXPRESS FEEDERS) ENSURE 150mm VERTICAL/SAND PADDING CLEARANCE BETWEEN CIRCUITS.

FIG. 2

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
02	NOV 2011	MM# ADDED	WB		PC	
01	SEPT 22 2008	TRENCH DIMENSIONS MODIFIED.	MC			

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	*	NOV.15, 2011

JOINT TRENCH - POWER & COMMUNICATION CABLES - TYPICAL

Dwg. No. DU-03-205.1 Rev. 02

PART #	MM#	DESCRIPTION	QTY.
1	30010134	CABLE PRIMARY, 28kV, UGROUND, 2/0 AWG, AL	
	30006080	CABLE PRIMARY, 28kV, UGROUND, 350 KCMIL, CU	
2	30007710	DUCT, PVC, 100mm, DIA	
3	30005908	SERVICE CABLE, UGROUND, 3/0AWG, 3 COND, AL	
	30005915	SERVICE CABLE, UGROUND, 250KCMIL, 3 COND, AL	
	30005959	SERVICE CABLE, UGROUND, 500KCMIL, 3 COND, AL	
4	20002181	CAUTION TAPE	

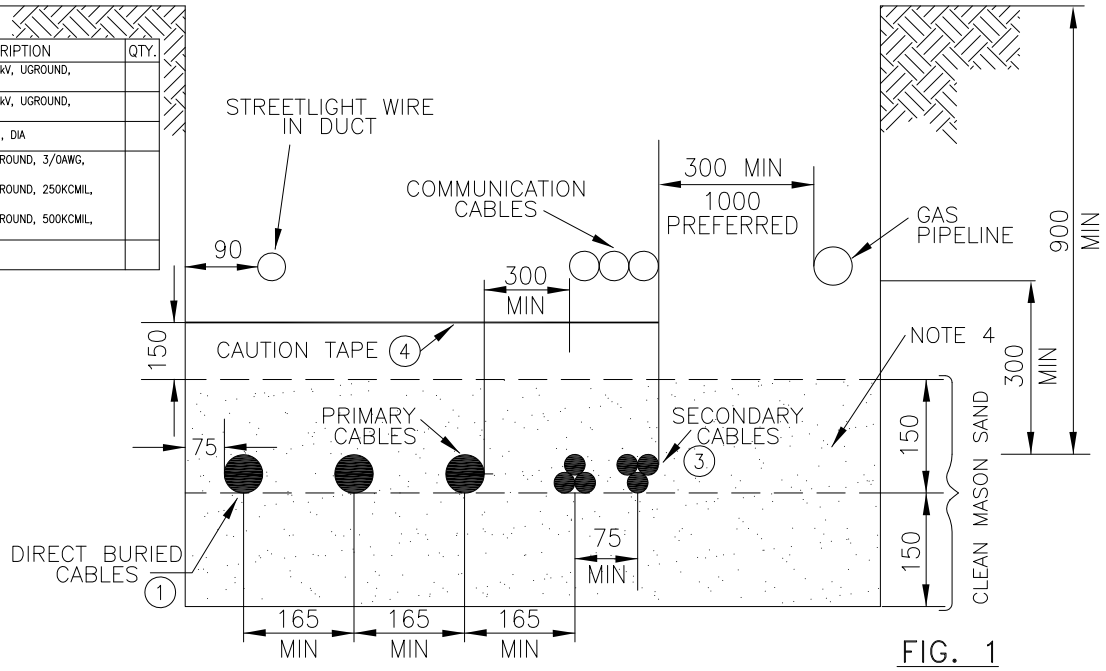
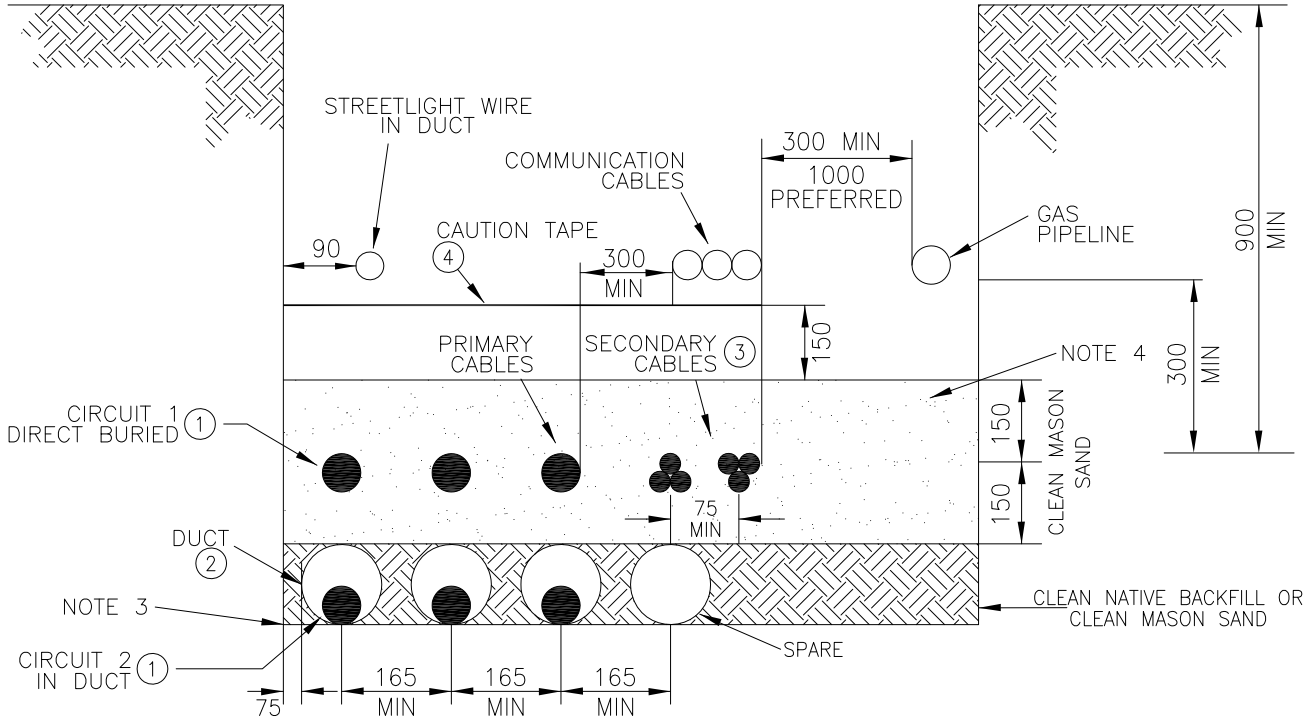


FIG. 1

SINGLE PRIMARY CIRCUIT



ALTERNATE SUPPLY CABLES IN SAME TRENCH AS MAIN SUPPLY CABLES (NOT PREFERRED)

FIG. 2

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. ALL SEPARATIONS AND DEPTHS OF BURIAL ARE MINIMUM.
3. IF TRENCH BOTTOM IS NOT LEVELED, AND FREE OF STONES & SHARP OBJECTS, THEN A 75mm THICK LAYER OF COMPACTED, CLEAN NATIVE BACKFILL OR CLEAN MASON SAND SHALL BE PLACED IN THE TRENCH BOTTOM BEFORE INSTALLING DUCTS.
4. FOR TRENCHING DURING FROST, THE SAND COVER SHALL BE 300mm, AND THE BACKFILL SHALL NOT CONTAIN ANY LUMPS OF ICE.

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

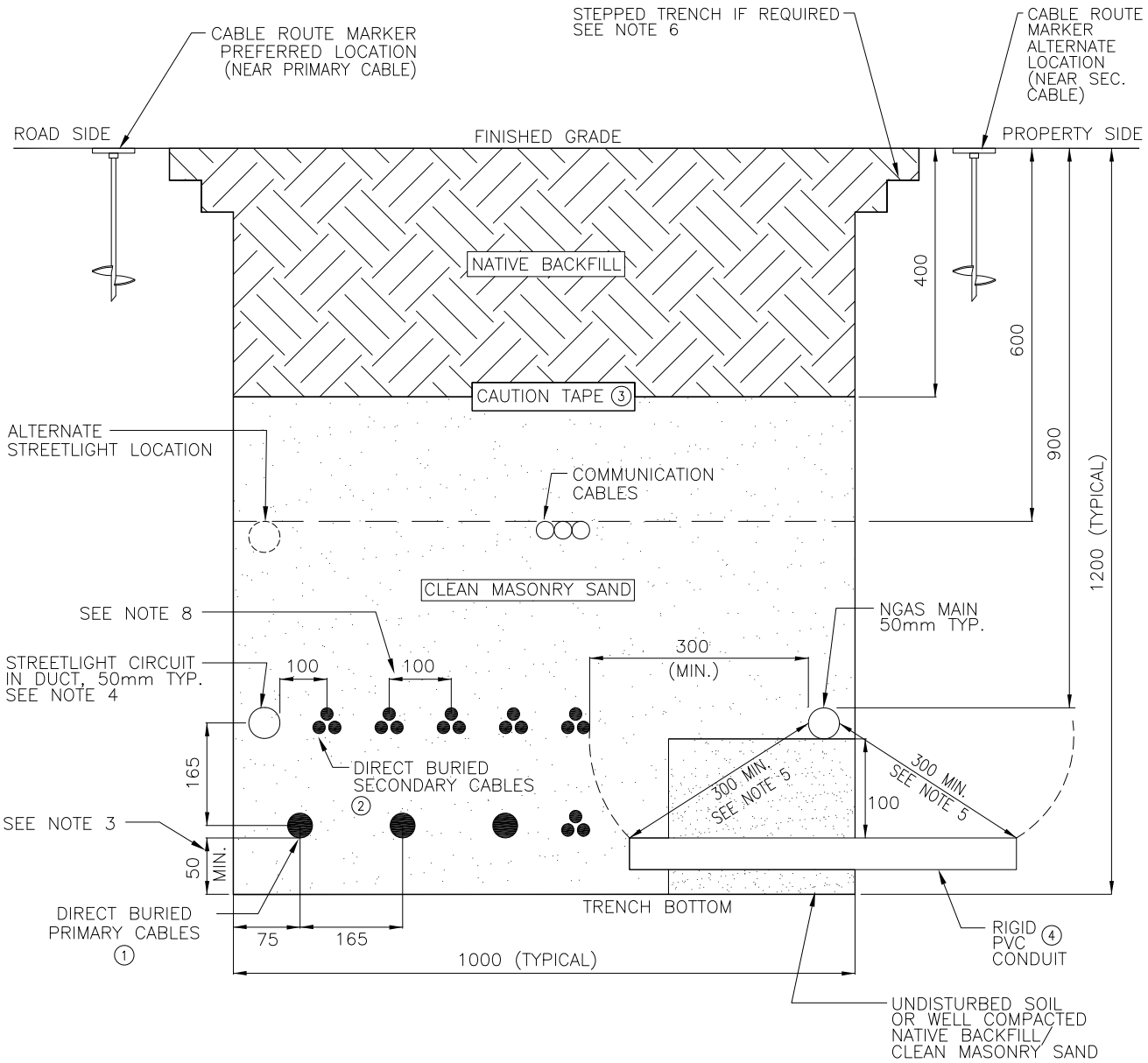
Rev. No.	Issue Date	Revision	Dwn	Approved By Date
03	NOV 2011	ADDED MM# & SPARE DUCT, REVISED 190mm TO 165mm	SO *	
02	OCT 2009	ADDED STREETLIGHT DUCT LOCATION	PC *	* *

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
M. CRONIN	*	NOV.15,2011

JOINT TRENCH - POWER, COMMUNICATION & GAS DISTRIBUTION LINES - TYPICAL

Dwg. No. DU-03-206 Rev. 03



NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. ALL SEPARATIONS AND DEPTHS OF BURIAL ARE MINIMUM.
3. IN THE PRESENCE OF SHARP ROCK, DEBRIS OR RUBBLE, INCREASE SAND PADDING TO 100mm
4. STREETLIGHT WIRE DUCT MAY BE INSTALLED AT A REDUCED BURIAL DEPTH, UP TO A MINIMUM DEPTH OF 600mm. SEPARATIONS TO SUPPLY CABLE BASED ON MAXIMUM STREETLIGHT DUCT DIAMETER OF 50mm.
5. MUST MAINTAIN 300mm MINIMUM FROM ALL EXPOSED SUPPLY CABLES TO GAS MAIN. WHEN CROSSING GAS MAIN AND IF 300mm OF CLEAR VERTICAL SEPARATION IS NOT ACHIEVABLE, SECONDARY CABLES SHALL BE INSTALLED IN SHORT LENGTH OF RIGID PVC CONDUIT.
6. CONSTRUCTION, STEPPING AND/OR SUPPORTING OF THE TRENCH WALL TO CONFORM TO THE REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT.
7. NON–REQUIRED CIRCUITS OR JOINT USE COMPONENTS MAY BE OMITTED PROVIDED THAT CLEARANCES AND SEPARATIONS ARE MAINTAINED. PRIMARY CABLES (IF PRESENT) MUST BE INSTALLED ON THE BOTTOM ROW OF SUPPLY CABLES. SECONDARY CABLE BUNDLES MAY BE SUBSTITUTED IN PLACE OF PRIMARY CABLE(S) WHEN REQUIRED.
8. INTERMITTENT CONTACT IS ALLOWABLE BETWEEN SECONDAY CABLES WHERE REQUIRED.

PART #	MASTER MATERIAL #	DESCRIPTION	QTY.
(1)	30010134 30006080	CABLE PRIMARY, 28kV, UGROUND, 2/0 AWG, AL CABLE PRIMARY, 28kV, UGROUND, 350 KCMIL, CU	
(2)	30005908 30005915	SERVICE CABLE, UGROUND, 3/0AWG, 3 COND, AL SERVICE CABLE, UGROUND, 250KCMIL, 3 COND, AL	
(3)	20002181	CAUTION TAPE	
(4)	30007542	RIGID PVC CONDUIT	

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
02	* *	*	PC	

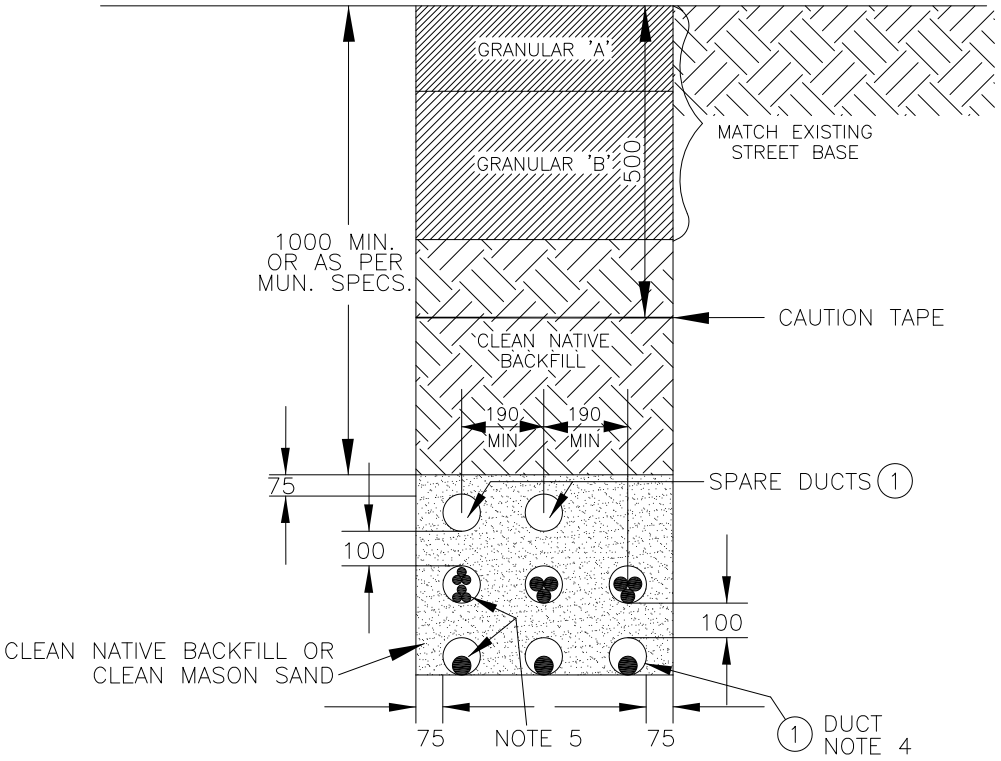
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
P.CIARMOLI	*	JULY.20,2011

JOINT TRENCH - POWER, COMMUNICATION & GAS DISTRIBUTION LINES - TYPICAL

Dwg. No. DU-03-206.1 Rev. 02

PART #	MM#	DESCRIPTION	QTY.
(1)	30007710	DUCT, PVC, 100mm DIA	



STANDARD STREET CROSSING

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. STREET CROSSING DUCTS TO BE INSTALLED AS PER MUNICIPAL SPECIFICATIONS TO A 1000mm MINIMUM DEPTH FROM FINAL GRADE. CENTER POINT TO BE ELEVATED TO PROVIDE 3% SLOPE TO EXTREMITIES.
3. BACKFILLING & COMPACTION SHALL BE AS PER MUNICIPAL SPECIFICATIONS, COMPACTION SHALL BE A MINIMUM OF 95% STANDARD PROCTOR DENSITY.
4. IF TRENCH BOTTOM IS NOT LEVELED, FREE OF STONES & SHARP OBJECTS, THEN A 75mm THICK LAYER OF COMPACTED, CLEAN NATIVE BACKFILL OR CLEAN MASON SAND SHALL BE PLACED IN THE TRENCH BOTTOM BEFORE INSTALLING DUCTS.
5. PRIIMARY CABLES SHALL BE IN THE LOWER DUCTS AND SECONDARY CABLES IN THE UPPER DUCTS.
6. THIS DRAWING ALSO APPLIES TO CABLES INSTALLED ACROSS DRIVEWAYS IN INDUSTRIAL & COMMERCIAL SUBDIVISIONS AND UNDER PAVED PARKING AREAS.
7. IN CASE OF ABSENCE OF SECONDARY CABLES IN THE TRENCH, THE PRIMARY CABLES CAN BE PLACED IN THE MIDDLE LEVEL DUCTS.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved / By / Date
03	NOV 2011	MM# ADDED	WB / PC	
02	NOV.07 2007	NOTES #6 & #7 ADDED.	AD / DP	D.PARIKH 11/07/07
01	SEP06 2006	GENERAL REVISIONS *	AM / DP	D.PARIKH 09/26/06

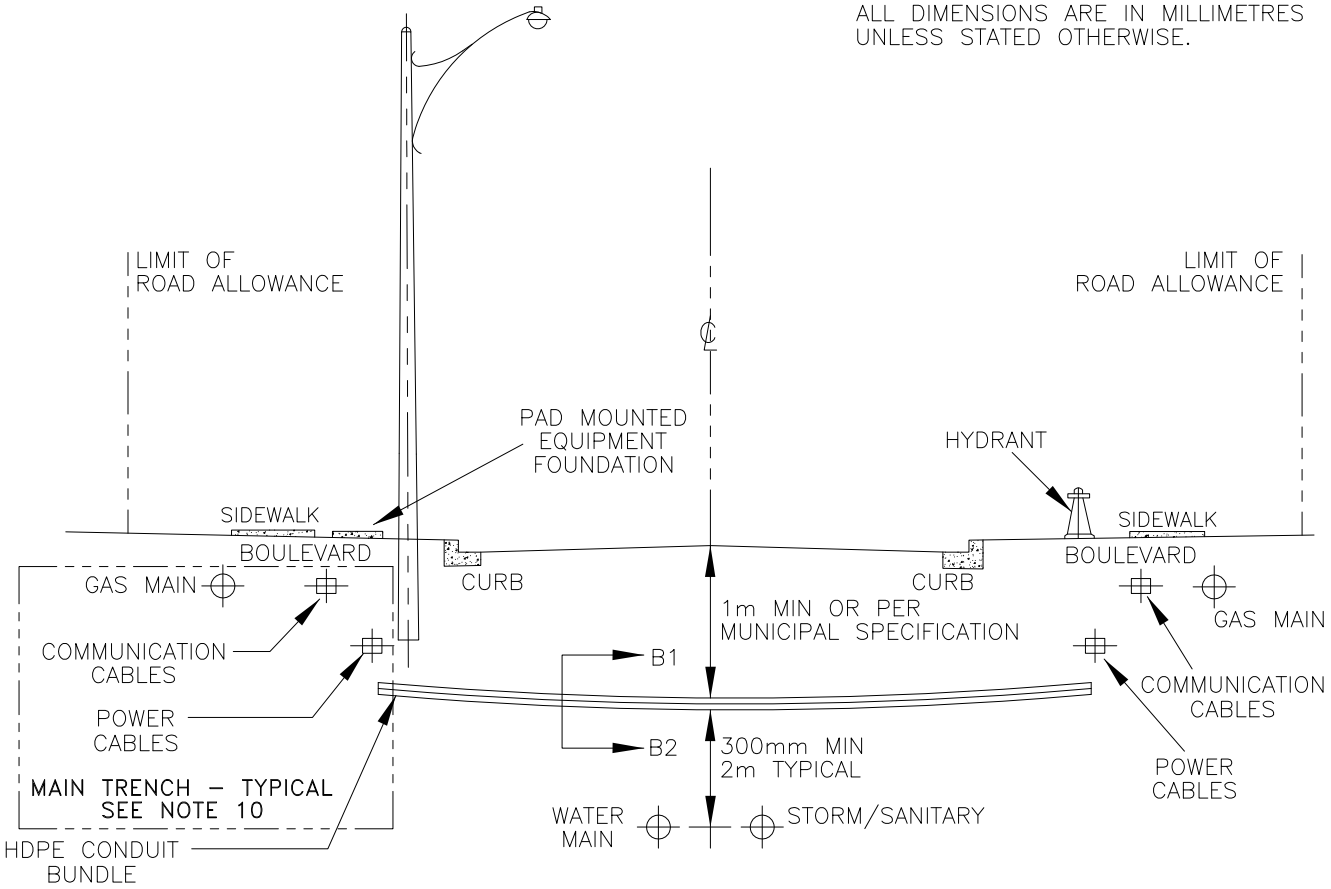
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	*	NOV. 22, 2011

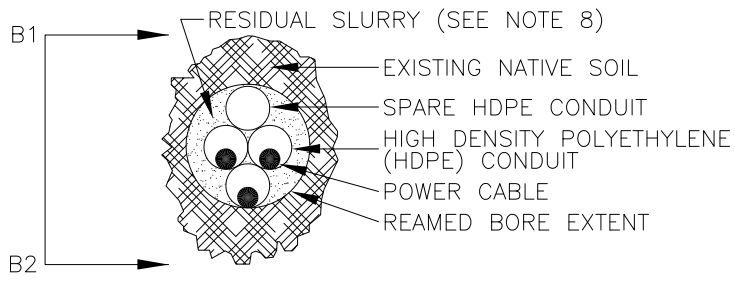
TRENCH, STREET CROSSING - TYPICAL.

Dwg. No. DU-03-207 Rev. 03

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.



DIRECTIONAL BORED STREET CROSSING – PROXIMITY TO UTILITIES – TYPICAL



SECTION B1–B2
CABLES IN HDPE CONDUIT

TABLE 1 – RECOMMENDED BORE DIAMETER	
TOTAL CONDUIT DIA. *	REAMED BORE DIAMETER
< 200mm	TOTAL CONDUIT DIA. +100mm
200mm – 600mm	TOTAL CONDUIT DIA. x1.5
> 600mm	TOTAL CONDUIT DIA. +300mm
* TOTAL CIRCUMSCRIBED DIAMETER OF MULTIPLEXED CONDUIT BUNDLE	

NOTES:

1. CONDUIT SHALL BE INSTALLED VIA HORIZONTAL DIRECTIONAL DRILLING (HDD) IN ACCORDANCE WITH LATEST VERSIONS OF ONTARIO PROVINCIAL STANDARD DOCUMENTS OPSS 450, OPSD 2103.6 AND OPSD 2103.5
2. HIGH DENSITY POLYETHYLENE (HDPE) CONDUIT TO BE SELECTED AND INSTALLED TO MANUFACTURERS SAFE MINIMUM BEND RADIUS, WORKING TENSION AND ULTIMATE OPERATIONAL LOAD ON A SITE SPECIFIC BASIS. HDPE CONDUIT SHALL MEET THE REQUIREMENTS EPEC–B TYPE AS SPECIFIED IN NEMA STANDARD TC–7.
3. CONTINUOUS LENGTHS OF FLEXIBLE HDPE CONDUIT MINIMUM 4" (100mm) DIAMETER NOMINAL WITH A SDR OF 13.5 SECTIONAL LENGTHS WELDED TO MANUFACTURERS SPECIFICATIONS ARE ALLOWED IF REQUIRED.
4. MAXIMUM BORE DIAMETER OF 600mm (9x4" CONDUIT TYP.) AND PER TABLE 1. MAXIMUM BORE LENGTH OF 500m UNLESS SPECIFIED BY DESIGN.
5. INSTALL ONE SPARE CONDUIT MINIMUM PER BORE OR AS PER DESIGN.
6. EACH CONDUIT TO BE FURNISHED WITH 7mm POLYPROPYLENE PULLING ROPE AND SEALED WITH HDPE TAPERED CAPS.
7. DRILLING FLUID CHARACTERISTICS (TYPICALLY A SOLUTION OF POTABLE WATER, BENTONITE, POLYMERS AND SURFACTANTS) TO BE DETERMINED BY INSTALLER PER LOCAL GEOLOGY AND DRILLING EQUIPMENT REQUIREMENTS.
8. RESIDUAL SLURRY (SOLUTION OF DRILLING FLUID AND BORE CUTTINGS) TO BE RETAINED IN THE FINISHED BORE AS MUCH AS PRACTICABLE.
9. BORE PATH TO BE AS STRAIGHT AS PRACTICABLE. AS BUILT DRAWINGS TO DOCUMENT FINAL BORE PATH TO BE SUBMITTED TO HYDRO ONE.
10. SPACINGS AND BURIAL DEPTHS WITHIN THE MAIN TRENCH PER APPLICABLE APPROVED STANDARD TRENCH DETAIL DRAWING(S).

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

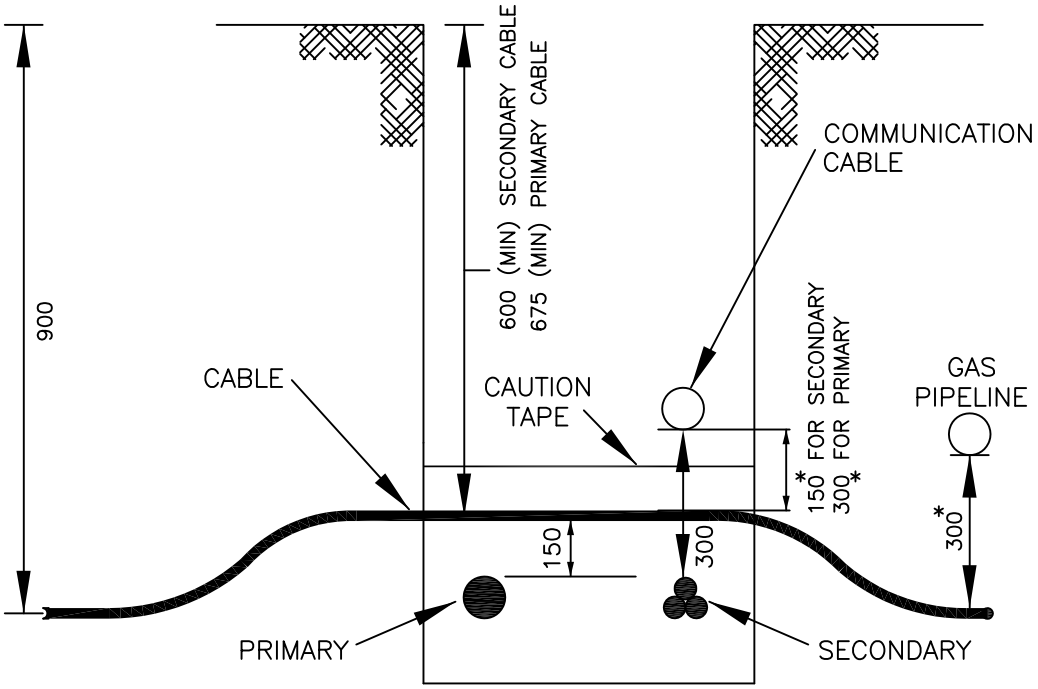
Rev. No.	Issue Date	Revision	Dwn	Approved By / Date
			* / *	* / *
01	OCT 2011	CHANGES TO NOTES *	PC / *	* / *

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
P.CIARMOLI	*	OCT.18,2011

POWER CABLES IN BUNDLED HDPE CONDUIT
DIRECTIONAL BORE INSTALLATION - TYPICAL

Dwg. No. DU-03-207.1 Rev. 01



JOINT TRENCH

NOTE:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. ALL DIMENSIONS ARE MINIMUM.
3. SEPARATION – SECONDARY SERVICES TO PRIMARY CABLES 150mm.
4. SEPARATION – ALL POWER CABLES TO GAS PIPELINE 300mm.
5. * INSTALL CABLE IN DUCT EXTENDING 600mm FROM THE OTHER UTILITY, IN BOTH DIRECTIONS AT CROSSING, IF THE SPECIFIED SEPARATION CANNOT BE ACHIEVED.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

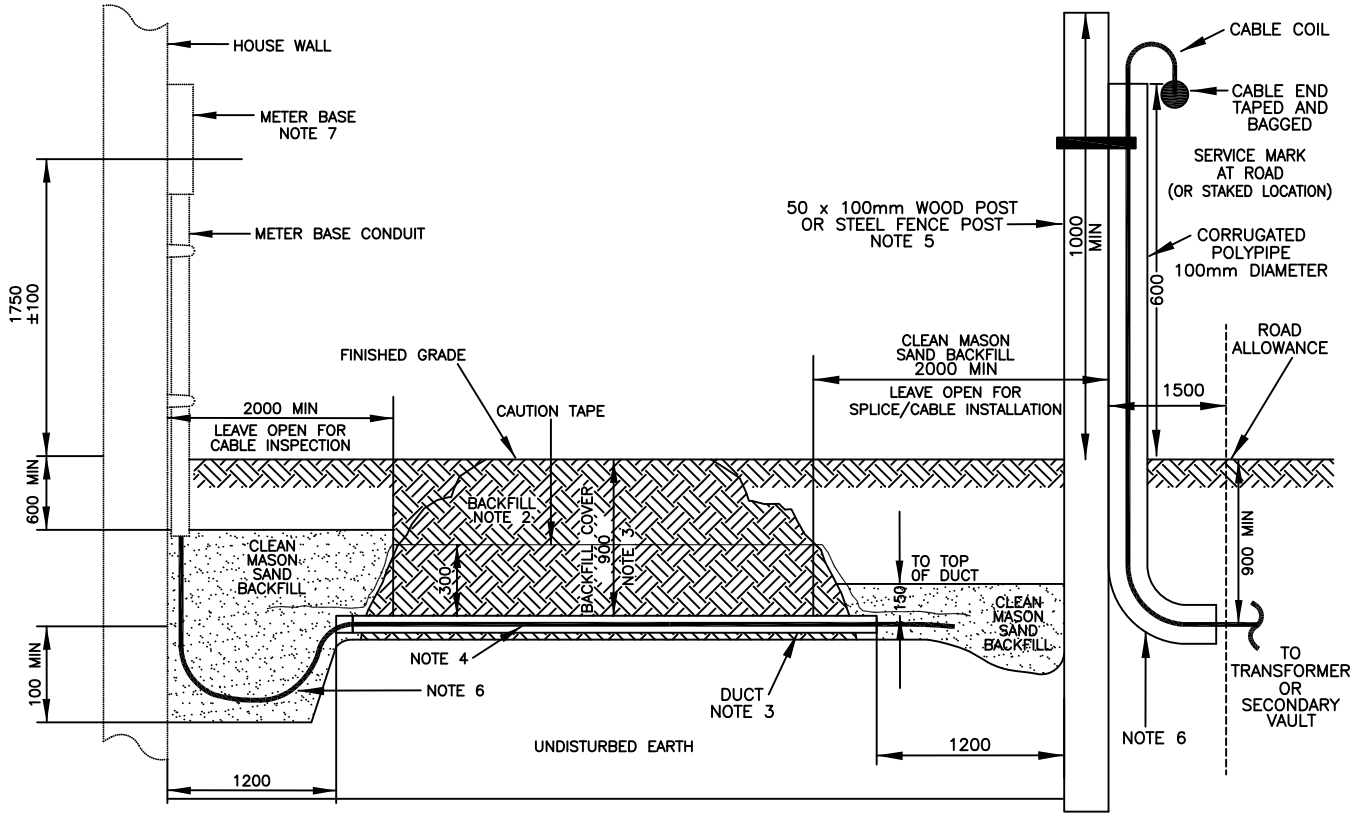
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
03	NOV 2011	ADDED NOTE 5 *	SO / *	* *
02	JAN10 2008	ADDED DIMENSION 675mm FOR PRIMARY CABLE DEPTH	JH / DP	D.PARIKH 02/19/08
01	SEP06 2006	GENERAL REVISIONS *	AM / DP	D.PARIKH 09/26/06

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	D.THOMPSON	NOV. 04, 2011

CROSSING ARRANGEMENTS OF GAS PIPE LINE, COMMUNICATION & POWER CABLES - TYPICAL

Dwg. No. DU-03-208 Rev. 03



NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. BACKFILL: MUST BE CLEAN AND FREE OF DEBRIS TO PREVENT DAMAGE TO THE DUCT. IT SHALL BE WELL TAMPED.
3. TRENCH & DUCT: THE TRENCH SHOULD BE AS STRAIGHT AS POSSIBLE. HOWEVER, IF CURVE IS NECESSARY, THE BEND SHOULD BE NO MORE THAN 45° OVER A 3m RADIUS. THE TRENCH MUST PROVIDE FOR A MINIMUM OF 600mm (900mm PREFERRED) OF COVER. "COVER" REFERS TO THE DISTANCE BETWEEN GRADE AND THE TOP OF THE DUCT OR CABLE. THE DUCT SHALL BE 100mm DIAMETER PVC TYPE "DB2". THE ENDS OF THE DUCT MUST BE CAPPED OR BAGGED TO PREVENT DEBRIS, FOREIGN OBJECTS AND WATER FROM ENTERING THE DUCT PRIOR TO CABLE INSTALLATION.
4. PULL ROPE: A 7mm DIAMETER POLYPROPYLENE PULL ROPE MUST BE INSTALLED THROUGH THE ENTIRE LENGTH OF THE DUCT. THIS ROPE IS USED TO INSTALL THE CABLE THROUGH THE DUCT.
5. WOOD OR STEEL POST SHALL EXTEND TO THE TRENCH BOTTOM, AS A MINIMUM.
6. RADIUS MUST BE GREATER THAN THE SPECIFIED CABLE MINIMUM BENDING RADIUS. LEAVE SOME SLACK TO ALLOW FOR GROUND SETTLEMENT.
7. METER BASE ASSEMBLY: INSTALL THE METER BASE ASSEMBLY ACCORDING TO ONTARIO ELECTRICAL SAFETY CODE. METER BASE TYPE SHALL BE AS SPECIFIED BY HYDRO ONE.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

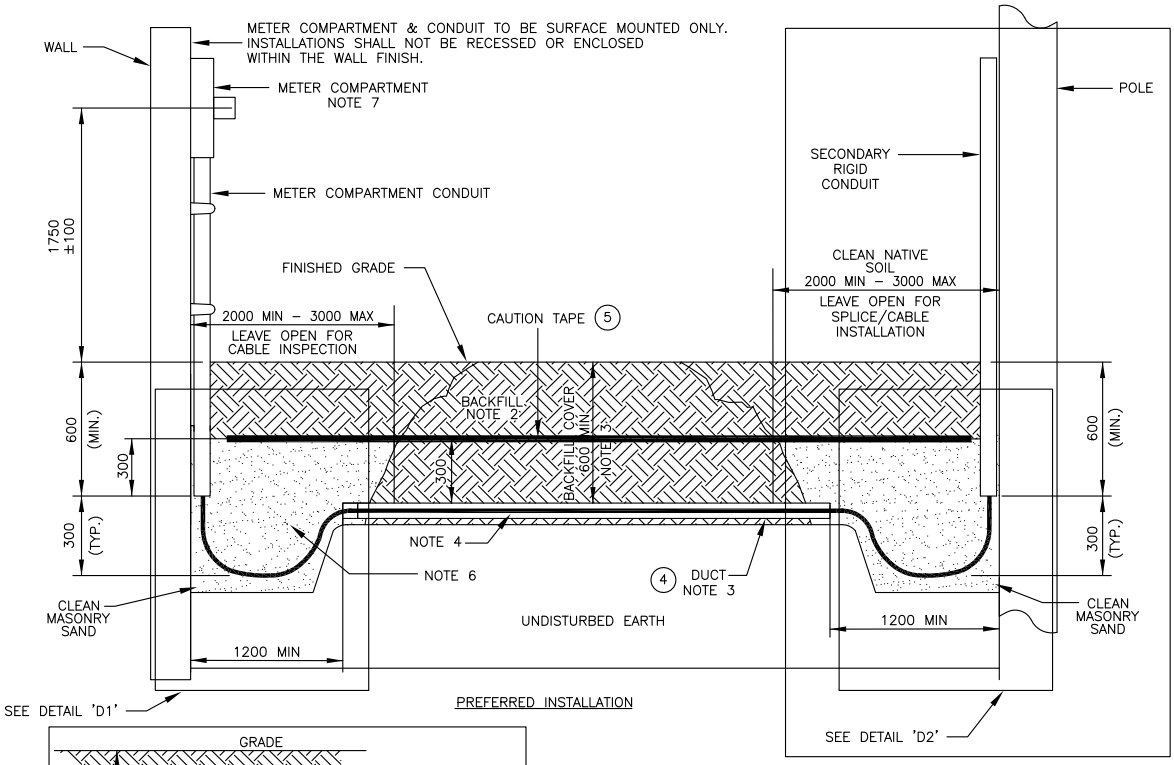
Rev. No.	Issue Date	Revision	Dwn	Approved
02	NOV 2011	GENERAL REVISIONS *	SP *	* *
01	SEP06 2006	GENERAL REVISIONS, COMBINED DU-03-209 & DU-03-217	AM DP	D.PARIKH 09/26/06

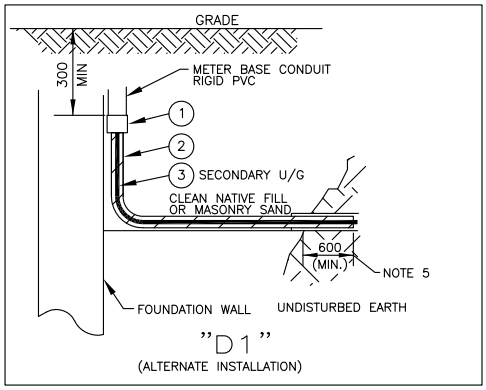
hydro one **Hydro One Networks Inc.**

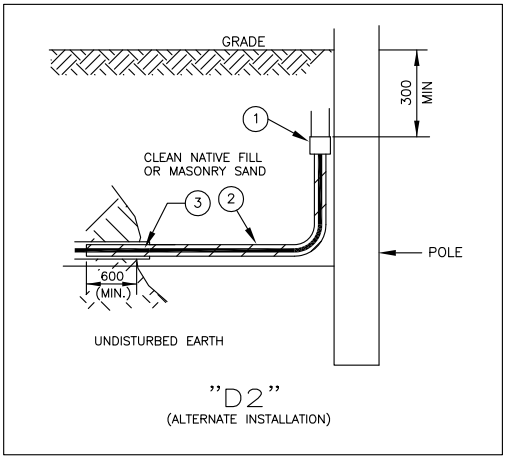
Drawn:	Approved:	Date:
S.OORT	*	NOV.04,2011

TRENCH DETAIL - METER BASE END OF SECONDARY SERVICE CABLE - TYPICAL

Dwg. No. DU-03-209 Rev. 02







NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. BACKFILL: MUST BE CLEAN AND FREE OF DEBRIS TO PREVENT DAMAGE TO THE DUCT. IT SHALL BE WELL TAMPED.
3. –THE TRENCH SHOULD BE AS STRAIGHT AS POSSIBLE. HOWEVER, IF CURVE IS NECESSARY, THE BEND SHOULD BE NO MORE THAN 45° OVER A 3m RADIUS.
   –STRAIGHT DUCT SHALL BE EMPLOYED IN THE TRENCH TO HOUSE THE CABLE. IT SHALL BE 100mm (4") DIAMETER PVC TYPE DBII. THE ENDS OF THE DUCT SHALL BE CAPPED OR BAGGED TO PREVENT DEBRIS AND MOISTURE FROM ENTERING THE DUCT PRIOR TO CABLE INSTALLATION. IF OPEN TRENCH ENDS MUST BE LEFT UNATTENDED AFTER CABLE INSTALLATION, THEY SHALL BE FITTED WITH A LENGTH OF FLEXIBLE CONDUIT TO MAKE 90° TRANSITION. CAUTION TAPE SHALL BE INSTALLED ALONG THE LENGTH OF THE FLEXIBLE CONDUIT.
   –AS AN ALTERNATE METHOD (NOT PREFERRED), FLEXIBLE CONDUIT CONTINUOUS FROM RIGID DIP POLE CONDUIT TO RIGID METER BASE CONDUIT MAY BE EMPLOYED.
4. PULL ROPE: A 7mm DIAMETER POLYPROPYLENE ROPE MUST BE INSTALLED THROUGH THE ENTIRE LENGTH OF THE DUCT. IF FLEXIBLE MECHANICAL PROTECTION IS USED, THE PULL TAPE SUPPLIED WITH PRODUCT IS APPROVED, THIS ROPE/TAPE IS USED TO INSTALL THE PULLING ROPE THROUGH THE DUCT.
5. INSTALL FLEXIBLE CONDUIT 600mm MIN. PAST THE EXPOSED LENGTH OF DBII IN TRENCH.
6. RADIUS MUST BE GREATER THAN THE SPECIFIED CABLE MINIMUM BENDING RADIUS.
7. INSTALL METER COMPARTMENT AS PER ELECTRICAL SAFETY CODE RULES, USE ONLY HYDRO ONE APPROVED 200A JUMBO SIZED METER COMPARTMENT CENTRE MOUNT WITH TUNNEL TYPE CONNECTORS AND HAVING THE MINIMUM DIMENSIONS OF 17"x12"x4–3/4" (432x305x121mm) CONTAINING 3" KNOCKOUTS. METER BASE TO MAINTAIN 1 METER MIN. CLEARANCE FROM DISCHARGE OF ANY COMBUSTIBLE GAS RELIEF DEVICE OR VENT.
8. TELECOMMUNICATION PLANT MAY SHARE SERVICE TRENCH BUT MUST BE INSTALLED IN ITS OWN CONDUIT.
9. GAS SERVICE SHALL NOT SHARE SERVICE TRENCH. IT MUST BE INSTALLED IN ITS OWN TRENCH. PREFERRED ROUTING IS ON OPPOSITE SIDE OF BUILDING THAN THAT OF THE ELECTRICAL SERVICE.

PART	MM#	DESCRIPTION	QTY.
1	30030348 30030236	COUPLER KIT, 2" FLEX TO 2" RIGID COUPLER KIT, 3" FLEX TO 3" RIGID	A/R
2	30030235 30030366	CONDUIT, FLEX, 2" CONDUIT, FLEX, 3"	A/R
3	30005908 30005915 30005959	SERVICE CABLE, 3/0AWG, 3 COND, AL SERVICE CABLE, 250KCMIL, 3 COND, AL SERVICE CABLE, 500KCMIL, 3 COND, AL	A/R
4	30007583	CONDUIT, PVC, 4", DBII	A/R
5	20002181	CAUTION TAPE, BURIED ELECTRIC LINE	A/R
		A/R = AS REQUIRED	

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
*	* *	*	* *	
*	* *	* *	* *	

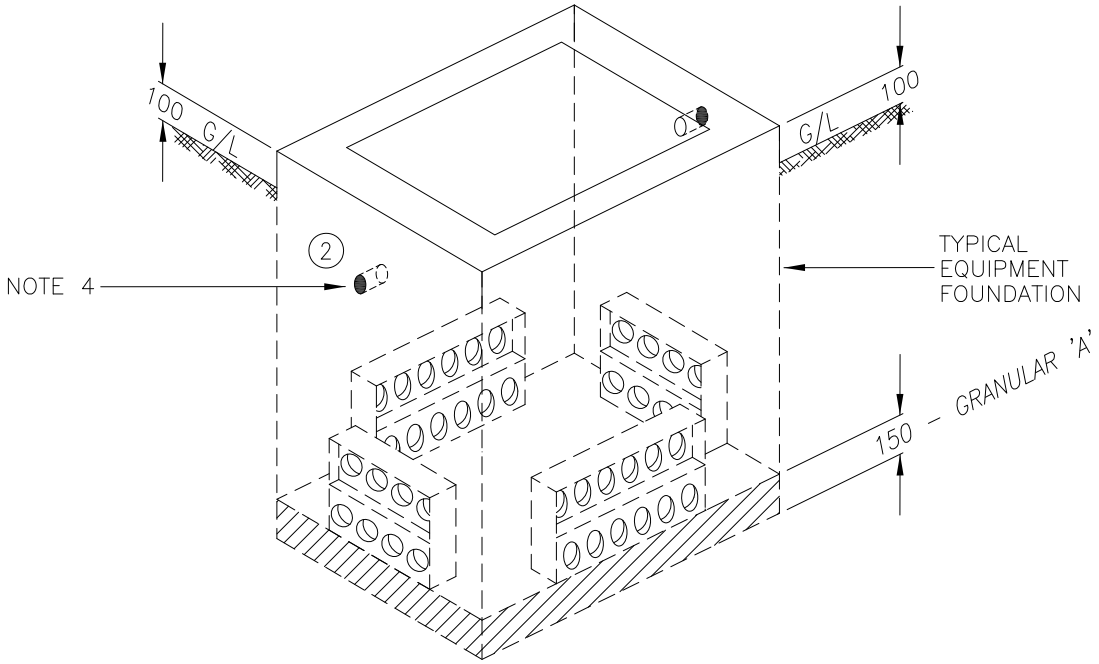
hydro one **Hydro One Networks Inc.**

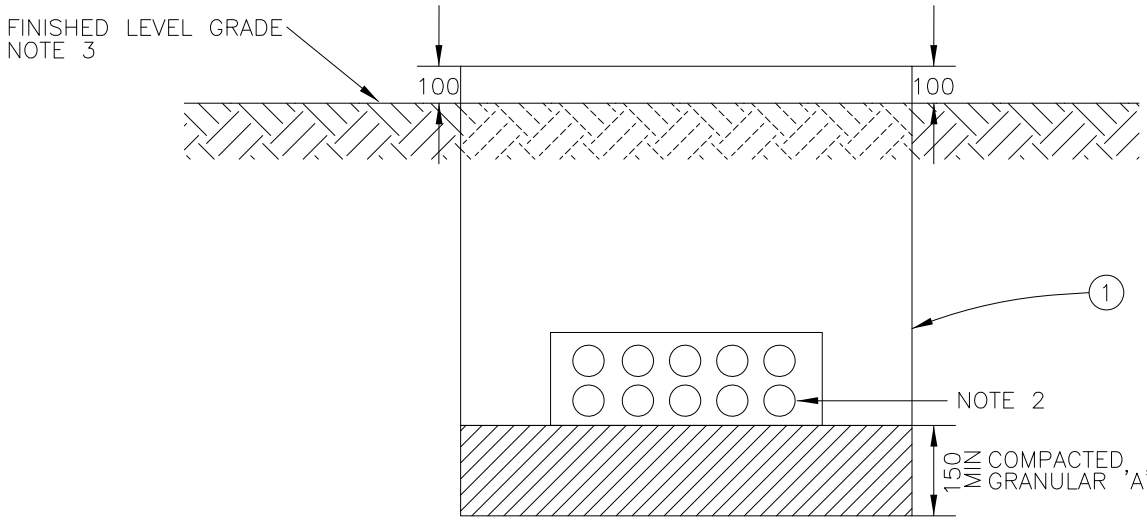
Drawn:	Approved:	Date:
L.SEQUEIRA	*	AUG.30,2012

TRENCH DETAIL - SECONDARY SERVICE CABLE - FROM DIP POLE

Dwg. No. DU-03-209.1 Rev. 00

PART #	MM #	DESCRIPTION	QTY.
(1)	AS NEEDED	DIST. EQUIPMENT FOUNDATION, CONCRETE PRECAST	1
(2)	30009051	SEALANT, COMPOUND, DUCT SEALING, 5LB	





NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. PRIMARY CABLES SHALL BE PLACED IN THE LOWER OPENINGS.
3. AFTER INSTALLATION OF CABLES AND GROUNDING, BACKFILL AND LEVEL THE SPACE, AS BELOW, TO THE PROPOSED FINAL GRADE LEVEL;
   – 3.0m SPACE IN FRONT OF FOUNDATION EDGE(S) ON OPERATING SIDE(S) OF EQUIPMENT.
   – 1.0m IN FRONT OF FOUNDATION EDGES FOR OTHER SIDES.
4. PLUG LIFTING HOLES WITH DUCT SEALING COMPOUND.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

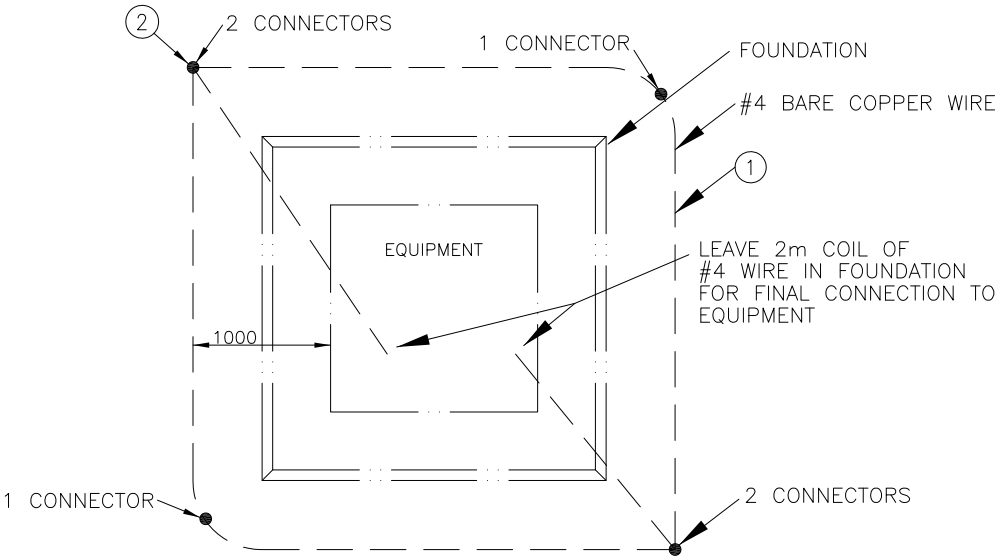
Rev. No.	Issue Date	Revision	Dwn	Approved By / Date
02	OCT 2011	MM# ADDED *	WB / PC	
01	SEP06 2006	GENERAL REVISIONS, WAS DU-03-213	AM / DP	D.PARIKH 09/26/06

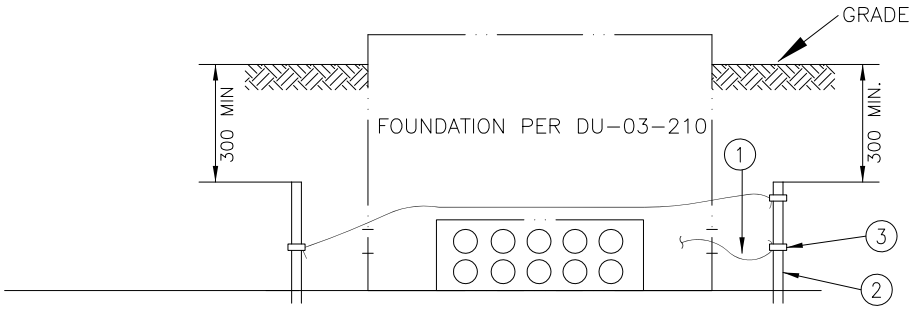
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	*	OCT. 27, 2011

EQUIPMENT FOUNDATION INSTALLATION

Dwg. No. DU-03-210 Rev. 02





REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

SEE SH. 2 FOR NOTES & MATERIAL LIST.

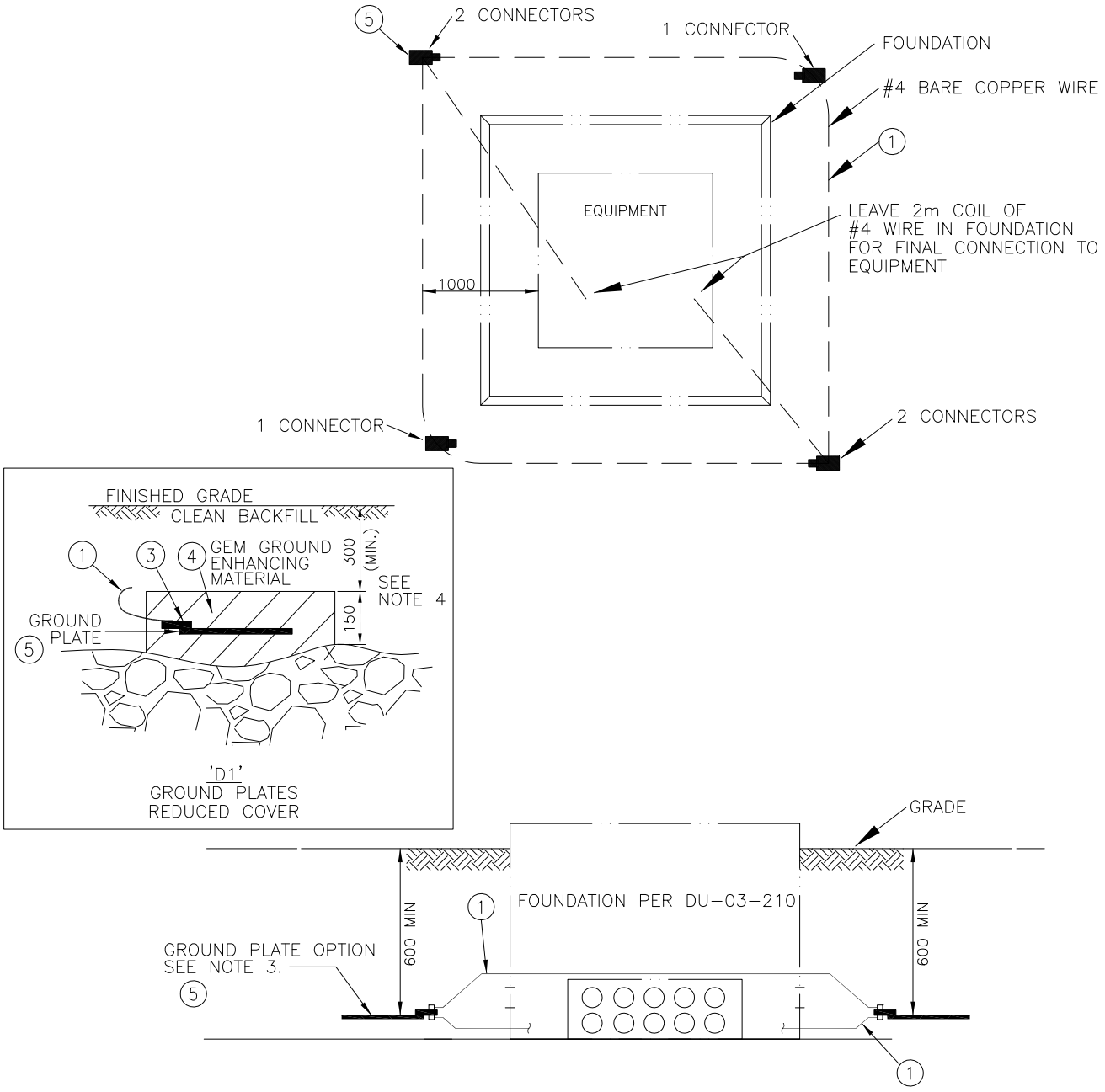
Rev. No.	Issue Date	Revision	Dwn	Approved By
03	NOV 2011	SPECIFIED FOUR GROUND RODS/PLATES	SO *	
02	JULY 2011	ADDITION OF 'D1' INSET	PC *	* *
			Chk	Date

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV.15,2011

PAD-MOUNTED EQUIPMENT GROUNDING DETAILS - TYPICAL

Dwg. No. DU-03-211 SH. 1/2 Rev. 03



REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. GAS PIPE LINES SHALL MAINTAIN MINIMUM 300mm (PREFERRED 600mm) SEPARATION FROM HYDRO ONE EQUIPMENT GROUND GRID.
3. GROUND RODS MAY BE SUBSTITUTED WITH GROUND PLATES ONLY IF GROUND RODS CANNOT BE DRIVEN DUE TO ROCKY GROUND CONDITIONS. MAINTAIN 600mm MINIMUM NATIVE SOIL COVER OVER PLATES AND 300mm OVER GROUND WIRE(S) PLATES INSTALLED AT REDUCED DEPTH MUST BE INSTALLED PER INSET 'D1'
4. MECHANICAL PROTECTION (75mm 21 MPa CONCRETE) IS REQUIRED OVER PLATES AND GROUND WIRES FOR BURIAL DEPTHS LESS THAN 300mm.

PART #	MM#	DESCRIPTION	QTY.
1	30014488	BARE COND, COPPER, #4 AWG	A/R
2	30014142	ROD, GROUND, 3/4" x 10ft, GALVANIZED	4
3	30006646	CONNECTOR, GRD WEDGE, GROUND ROD TO #4 COPPER WIRE	6
4	30025402	GEM MATERIAL	A/R
5	30025401	GROUND PLATE	4

A/R – AS REQUIRED

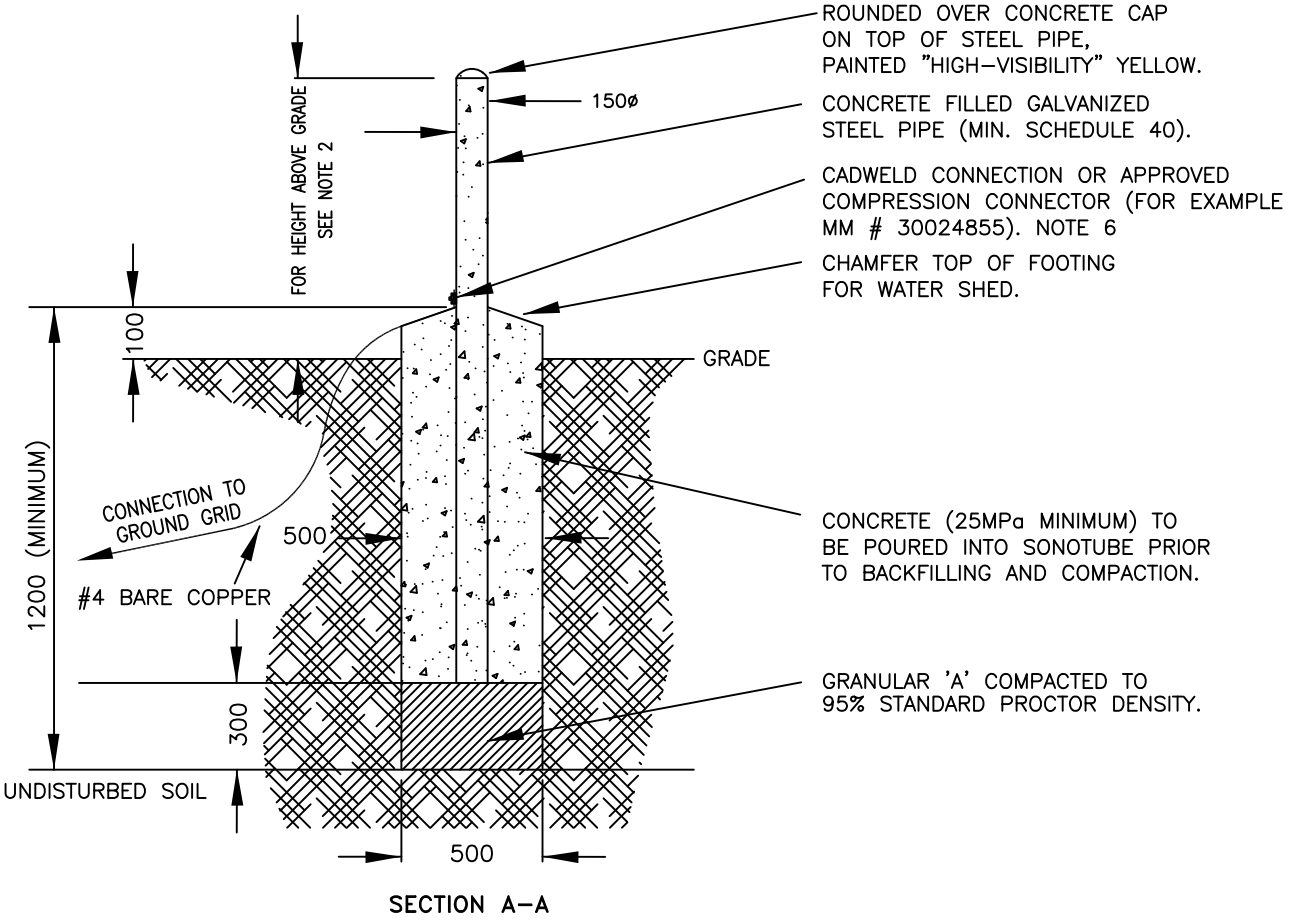
Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
03	NOV 2011	SPECIFIED FOUR GROUND RODS/PLATES	SO *	*		
02	JULY 2011	ADDITION OF 'D1' INSET	PC *	*		

hydro one **Hydro One Networks Inc.**

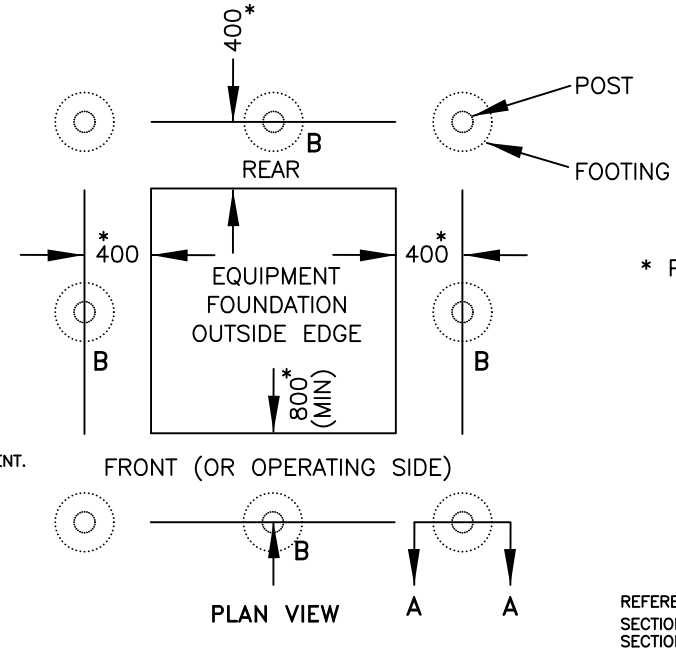
Drawn:	Approved:	Date:
S.OORT	*	NOV.04,2011

PAD-MOUNTED EQUIPMENT GROUNDING DETAILS - TYPICAL

Dwg. No. DU-03-211 SH. 2/2 Rev. 03



SECTION A–A



PLAN VIEW

* PREFERRED 1500mm

NOTE:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE
2. PROTECTIVE BOLLARD HEIGHT ABOVE GRADE:
   FOR SINGLE PHASE EQUIPMENT – 900
   FOR THREE PHASE EQUIPMENT – 1200
3. BOLLARDS SHALL BE PROVIDED AS SHOWN ON DESIGN DRAWINGS.
4. BOLLARDS AT 'B' ARE OPTIONAL AND WOULD ONLY BE REQUIRED FOR HIGH TRAFFIC AREAS AND LARGE SIZED EQUIPMENT. BOLLARDS AT 'B' ARE GENERALLY NOT REQUIRED FOR SINGLE PHASE EQUIPMENT DUE TO THEIR SMALL SIZE.
5. LOCATION OF BOLLARDS SHOULD NOT OBSTRUCT EQUIPMENT OPERATION, MAINTENANCE AND REPLACEMENT.
6. WHEN USING COMPRESSION CONNECTOR DRILL THROUGH HOLE IN THE PIPE, AND REMOVE PAINT FROM CONNECTION AREA OF THE PIPE.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

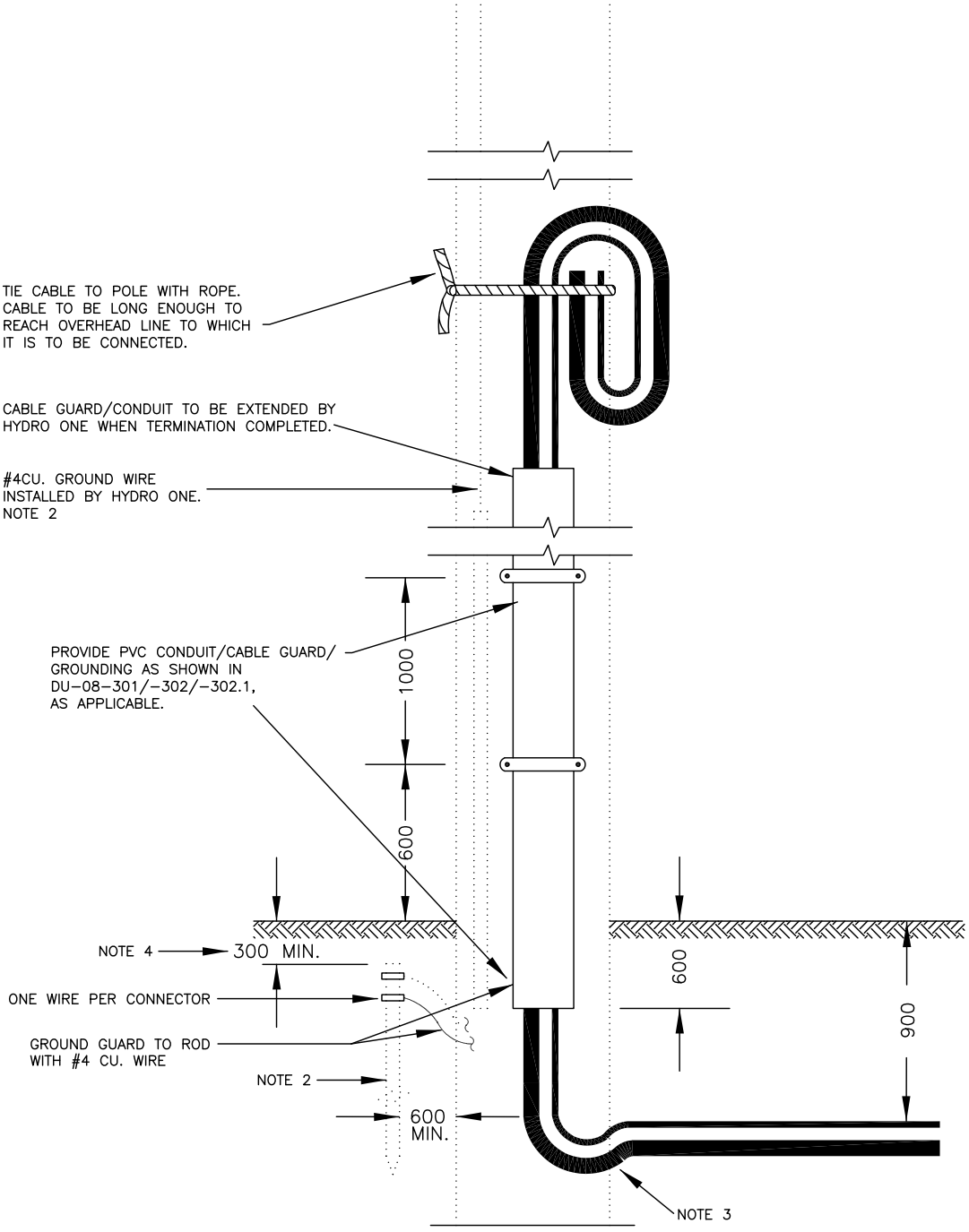
Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
03	NOV 2011	NOTE 4 ADDED PREFERRED DIMENSIONS SPECIFIED. COMPRESSION CONNECTOR ADDED.	SO	*	*	*/*/*
02	NOV.07 2007	ADDED CENTER POST & FTG ON FRONT SIDE.	AD	DP	D.PARIKH	11/07/07

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV.04,2011

PROTECTIVE BOLLARDS INSTALLATION

Dwg. No. DU-03-212 Rev. 03



NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. IF GROUND ROD & GROUND WIRE DO NOT ALREADY EXIST WHEN CONTRACTOR PLACES CABLES, THEN THEY SHALL BE INSTALLED BY CONTRACTOR.
3. RADIUS MUST BE GREATER THAN THE SPECIFIED CABLE MINIMUM BENDING RADIUS. LEAVE SOME SLACK TO ALLOW FOR GROUND SETTLEMENT.
4. INCREASE DEPTH TO 500mm IN CULTIVATED LAND.

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITION
SECTION 16 – MATERIALS

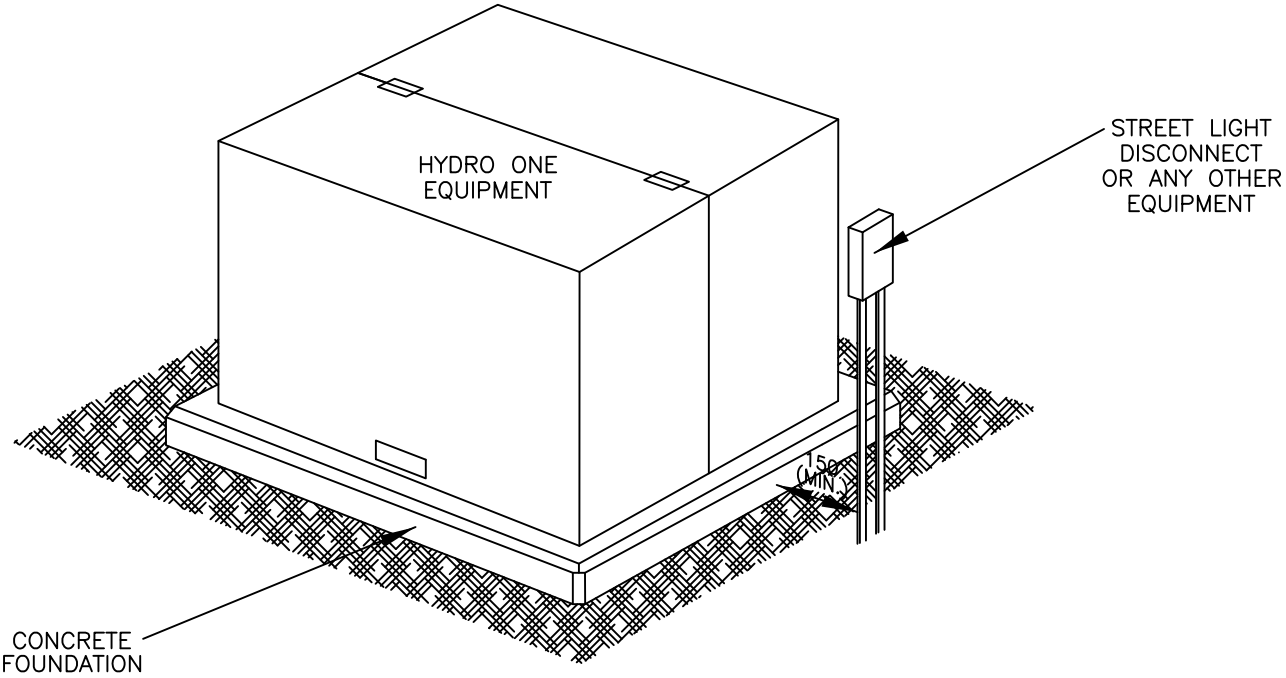
Rev. No.	Issue Date	Revision	Dwn	Approved By / Date
02	NOV 2011	DELETED CADWELDING & PARTS LIST	SO *	* *
01	SEP06 2006	GENERAL REVISIONS, WAS DU-03-216	AM DP	D.PARIKH 09/26/06

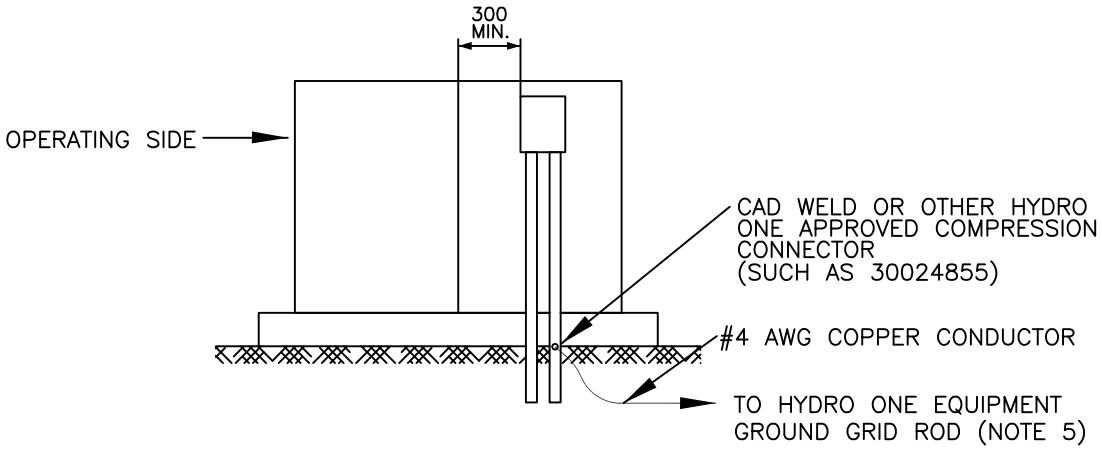
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	D.THOMPSON	NOV. 04, 2011

TEMPORARY TERMINATION OF U/G CABLE BY CONTRACTOR FOR FUTURE CONNECTION TO HYDRO ONE OVERHEAD LINE

Dwg. No. DU-03-213 Rev. 02





NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. DO NOT DRILL OR TAP EQUIPMENT CASING OR FOUNDATION.
3. ALL METAL PARTS WITHIN 3m OF EQUIPMENT GROUND GRID SHALL BE CONNECTED TO THIS GRID WITH MINIMUM #4 AWG COPPER CONDUCTOR.
4. LOCATION OF STREET LIGHT OR COMMUNICATION EQUIPMENT SHALL NOT OBSTRUCT INSTALLATION AND MAINTANENCE OF HYDRO ONE EQUIPMENT.
5. SEE DU-03-211 FOR HYDRO ONE EQUIPMENT GROUND GRID DETAILS.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
02	NOV 2011	ADDED COMPRESSION CONNECTOR	SO / *	* *
01	SEP06 2006	GENERAL REVISIONS, WAS DU-03-218	AM / DP	D.PARIKH 09/26/06

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV. 04, 2011

STREET LIGHT DISCONNECT, OR COMMUNICATION CABLE PEDESTAL NEAR HYDRO ONE PAD-MOUNTED EQUIPMENT

Dwg. No. DU-03-214 Rev. 02

SUB-SECTION 3C-3
SINGLE PHASE PAD-MOUNTED TRANSFORMERS

Sub-Section 3C-3
Single-Phase Pad-Mounted Transformers

Installation	Single-phase pad-mounted transformers shall be installed, and connected, in accordance with drawing DU-03-301. Transformers shall be placed on foundations that are installed as per Sub-Section 3C-2 and drawing DU-03-210. The location of transformers and foundations shall be as specified in Sub-Section 3C-2. For required foundation see section 9.
Elbows and Bushings	Adequate length of cables shall be left inside the transformer foundation for cable termination and to facilitate ease in elbow operations. Unused transformer bushings shall be protected by an appropriate insulating cap. See DU-03-301 for details. Hydro One supplies and installs the load break elbows, bushing inserts and insulating caps.
Identification and Labels	Approved labels/markers, as outlined in DU-03-302, shall be used to identify transformers. The labels/markers shall include the transformer location number, the phase to which the transformer is connected, transformer rating, the Caution signs and the Danger signs. Hydro One supplies and installs the labels and markers.
Fault Indicators	Fault indicators are to be installed on the cable that is connected to the H1B terminal (outgoing cable side) of every transformer. Fault indicator installation shall be as per drawings DU-03-301. Application criteria for different types of fault indicators is specified in Sub-Section 3D. Hydro One supplies and installs the fault indicators.
Lightning Arresters	Lightning arresters, for surge protection of transformers and primary cables connected to the transformers, are to be applied as specified in Sub-Section 3D. Hydro One supplies and installs the arresters.
Grounding	Transformers shall be connected to their ground grid as per drawing DU-03-301, with a minimum #4 AWG bare copper wire and approved ground connectors. For ground grid details see DU-03-211. The final connection of ground grid wires to the transformer H2 and tank ground terminals, and to cable neutral wires, is done by Hydro One.

Bonding

All above ground metallic parts of other equipment (such as the metallic street light disconnect or bollards) located within 3 m of the transformer ground grid, shall be bonded to the ground rod of this grid. Bonding shall be done with a minimum #4 AWG bare copper wire and cad-weld or approved compression type ground connectors. See DU-03-212 / DU-03-214 for typical details of bonding.

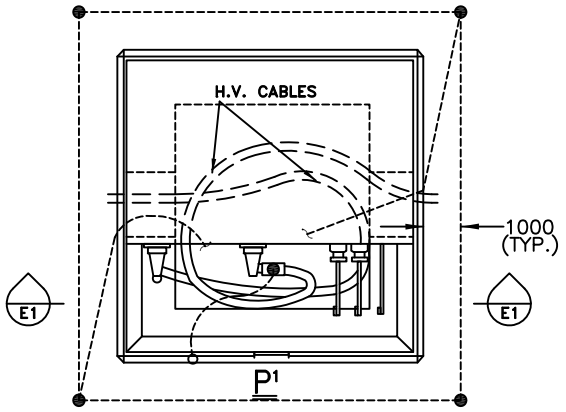
Temporary Measures

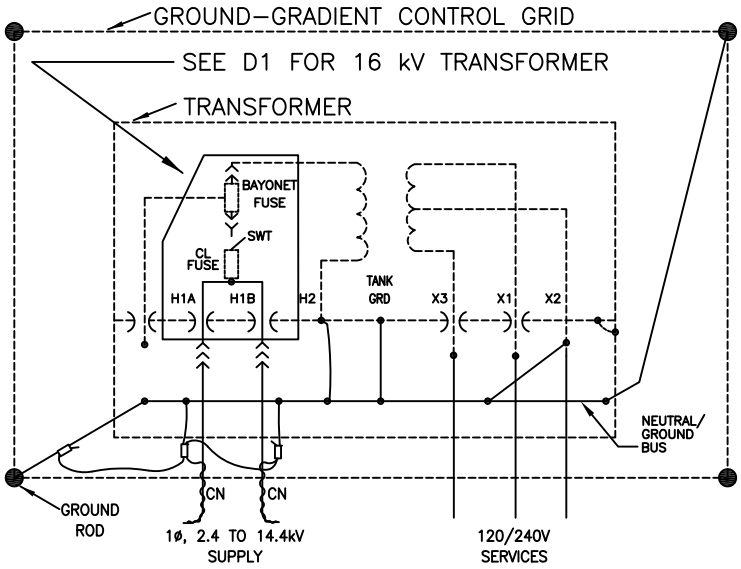
Buck phasing in transformers is not permitted, however the use of a feed-through insert to establish an extra temporary connection is acceptable. If a feed-through insert is used, then inside that transformer, the fault indicator is installed on both the cables feeding the load. All temporary measures are to be clearly indicated on the drawings, along with the expected duration of the need, and shall be approved by the Hydro One Design Engineer. Clear signage and marking is to be placed within the transformer to identify the non-standard situation.

In This Section

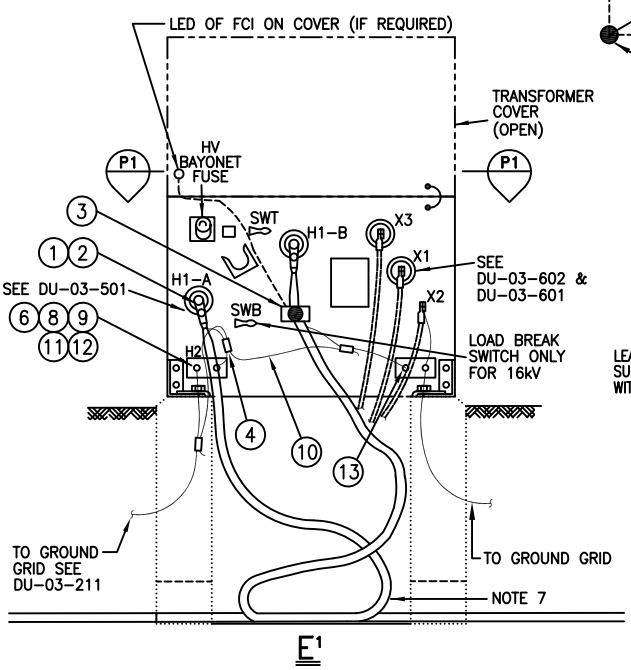
This section contains the following drawings:

Description	Dwg. #	Rev.
Single-Phase Pad-Mounted Transformer Installation and Connections	DU-03-301	R2
Signs and Markers on Single-Phase Pad-Mounted Transformer	DU-03-302	R2

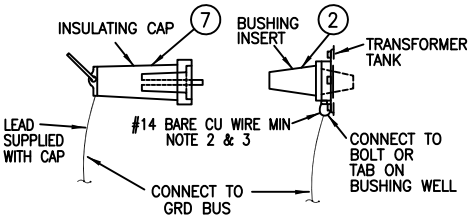




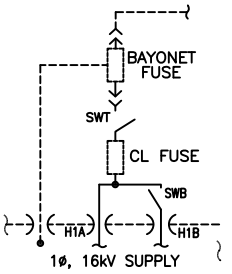
WIRING AND GROUNDING DIAGRAM



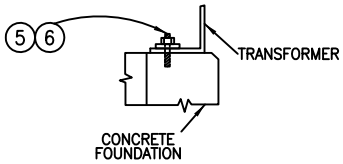
E1



GROUNDING OF INSULATING CAP AND/OR BUSHING INSERT



D1



FOUNDATION CLAMPS FOR TRANSFORMER

PART #	MM #	DESCRIPTION	QTY.
1*	30007476	ELBOW, LOADBREAK	2
2*	30007479	BUSHING UGRD, INSERT, LOADBREAK	2
3*	30018800 30011252	FAULT CIRCUIT INDICATOR, with REMOTE LIGHTED INDICATOR, 4hr RESET FAULT CIRCUIT INDICATOR, with MECHANICAL INDICATOR, CURRENT RESET	1
4	30006154	CONNECTOR, TAP BLTD COND TO COND	3
5	10000081	BOLT, HEX HEAD GALV GR2, 1/2" DIA, 1" LG	4

PART #	MM #	DESCRIPTION	QTY.
6	30001605	WASHER, LOCK HELICAL SPRING, 1/2" BOLT,	4
7	30007478	CAP UGRD, INSULATING, 28Kv	1 MAX
8	30001184	BOLT, 1/2" DIA, 1–1/2" LG, SI–BR	5
9	30006864	CONNECTOR, TERM, COMP PAD, 12mm HOLE	1
10	30014480	BARE COND, COPPER, 4AWG	3m
11	30001499	NUT, 1/2", SI–BR	5
12	30001681	WASHER, 1/2", SI–BR	5
13	30006431	CONNECTOR, COMPRESSION, FOR CN WIRES (2/0 CABLE)	2

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. COVER ANY UNUSED BUSHING INSERTS WITH INSULATING CAP AND GROUND IT.
3. USE CONCENTRIC NEUTRAL STRAND FROM DISCARDED SECTION OF U/G CABLE.
4. FOR FOUNDATION INSTALLATION DETAILS SEE DU–03–210.
5. FOR GROUNDING DETAILS SEE DU–03–211.
6. FOR SECONDARY CONNECTION DETAILS SEE DU–03–501.
7. DO NOT BEND CABLES MORE THAN THE PERMISSIBLE MINIMUM BENDING RADIUS OF 10 x DIAMETER.
8. PART #'s MARKED WITH '*' ARE SUPPLIED & INSTALLED BY HYDRO ONE.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

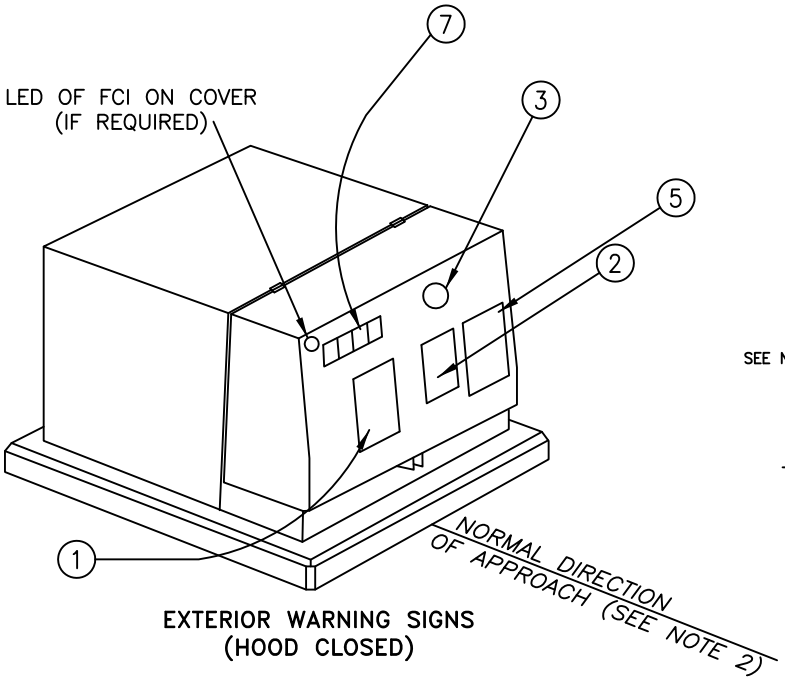
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
02	NOV 2011	GENERAL REVISIONS, ADDED MM#, 4 RODS & GROUNDING DETAILS	SO / *	* *
01	SEP06 2006	GENERAL REVISIONS *	AM / DP	D.PARIKH 09/26/06

hydro one **Hydro One Networks Inc.**

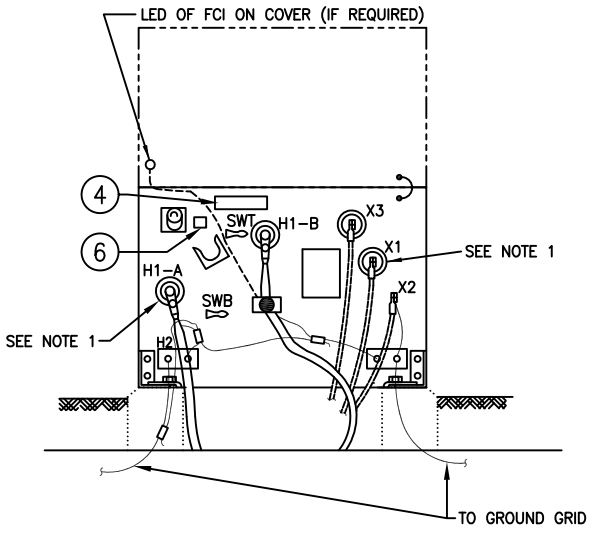
Drawn:	Approved:	Date:
S.OORT	*	NOV.15, 2011

SINGLE-PHASE PAD-MOUNTED TRANSFORMER INSTALLATION AND CONNECTIONS

Dwg. No. DU-03-301 Rev. 02



EXTERIOR WARNING SIGNS
(HOOD CLOSED)



INTERIOR WARNING SIGNS
(HOOD OPEN)

PART #	MM #	DESCRIPTION	QTY.	REMARKS
1	20002130	VISUAL SIGN, "DANGER HIGH VOLTAGE"	1 MIN	LOCATE ON MOST NOTICABLE SIDE(S). REQUIRED ON ALL UNITS.
2	20002125	VISUAL SIGN "DANGER, DO NOT DIG OR DRIVE STAKES"	1 MIN	LOCATE ON MOST NOTICABLE SIDE(S). REQUIRED ON ALL UNITS.
3	20001694 20001695 20001696	VISUAL SIGN, "RED PHASE" SAME--"WHITE PHASE" SAME--"BLUE PHASE"	1 MIN	LOCATE ON MOST NOTICABLE SIDE(S). REQUIRED ON ALL UNITS. (SEE NOTE B)
4	20001595	VISUAL SIGN, "CAUTION LOOP FEED"	1	USE FOR LOOP FEED CONNECTED TRANSFORMERS ONLY.
5	20002119	VISUAL SIGN, "DANGER, DO NOT OPEN YOU CAN BE HURT"	1	NORMALLY SUPPLIED BY TRANSFORMER MANUFACTURER. LOCATE ON MOST NOTICABLE SIDE(S). REQUIRED ON ALL UNITS.
6	20002182	VISUAL SIGN "DO NOT OPERATE FUSE...."	1	NORMALLY SUPPLIED BY TRANSFORMER MANUFACTURER, REQUIRED ON ALL UNITS SUPPLIED WITH DRY WELL CANISTERS.
7	20001563 to 20001571	VISUAL SIGN, "LOCATION NUMBER (No. 0 to 9)"	A/R	AS REQUIRED

NOTES:
1. FOR IDENTIFICATION OF PRIMARY AND SECONDARY CABLES SEE DU-03-501, DU-03-602.
2. IF DIRECTION OF APPROACH IS DIFFERENT THAN INDICATED, ADD LOCATION NUMBER (PART 7) AND PHASE MARKER (PART 3) TO THAT SIDE.
3. THE ABOVE SIGNS AND MARKERS (EXCEPT PART 6) SHALL ALSO BE PROVIDED ON KIOSK/SWITCH GEAR.
4. UNLESS SPECIFIED OTHERWISE, ALL THE SIGNS & MARKERS ARE SUPPLIED AND INSTALLED BY HYDRO ONE.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
02	NOV 2011	ADDED MM #'S *	SO / *	* *
01	SEP06 2006	GENERAL REVISIONS *	AM / DP	D.PARIKH 09/26/06

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV. 04, 2011

SIGNS & MARKERS ON SINGLE-PHASE PAD-MOUNTED TRANSFORMER

Dwg. No. DU-03-302 Rev. 02

SUB-SECTION 3C-4
SINGLE PHASE PRIMARY SWITCHING DEVICES KIOSKS & SWITCHGEAR

Sub-Section 3C-4
Single-Phase Primary Switching Devices – Kiosks and Switchgear

Installation	Single-phase switching devices shall be installed as shown on drawing DU-03-401 and DU-03-402. Switching equipment shall be placed on foundations which are installed as specified in Sub-Section 3C-2 and drawing DU-03-210. Location of kiosks/switchgear shall be as specified in Sub-Section 3C-2. For required foundation see section 9.
Elbows and Bushings **Review fused elbows use**	Adequate length of cables shall be left inside the equipment foundation for cable termination and to facilitate ease in elbow operations. Unused bushings shall be protected by an appropriate insulating cap. For details of insulating cap installation, see DU-03-301. Hydro One supplies and installs the load break elbows, bushing inserts and insulating cap.
Identification and Labels	Approved labels/markers as outlined in DU-03-302, shall be used to identify kiosks/switchgear. The labels/markers shall include the kiosk/switchgear location number, and the phase(s) to which the kiosk/switchgear is connected, the Caution signs and the Danger signs. Hydro One supplies and installs the labels and markers.
Fault Indicators	Mechanical type fault indicators are to be installed on the cables that are connected to all outgoing (tap) bushings of kiosks/switchgear, except that fault indicators are not required on cables connected to the fault interrupter switches of switchgear. Application criteria for different types of fault indicators is specified in Sub-Section 3D. Fault indicator installation shall be as per drawing DU-03-401. Hydro One supplies and installs the fault indicators.
Lightning Arresters	Lightning arresters, for surge protection of switching equipment and primary cables connected to such equipment, are to be applied on the equipment bushings as specified in Sub-Section 3D. This protection is not required if there is at least one outgoing cable from the equipment. If kiosk has only one cable (for example temporary cable for a future extension of the subdivision or “buck phasing”) then the arresters shall be used for the cable protection. Hydro One supplies and installs the arresters.
Grounding	Kiosk/switchgear shall be connected to its ground grid as per drawing DU-03-401 / DU-03-402 with minimum #4 AWG bare copper wire and approved ground connectors. For ground grid details see DU-03-211. The final connection of ground grid wires to the kiosk/switchgear ground terminals / ground bus and cable concentric neutral wires is done by Hydro One.

Bonding

All above ground metallic parts of other equipment (such as the metallic street light disconnect or bollards) located within 3 m of switching device ground grid, shall be bonded to this ground grid. Bonding shall be done with a minimum #4 AWG bare copper wire and a cad-weld or approved compression type ground connectors. See DU-03-212/ DU-03-214 for typical details of bonding.

Temporary Measures

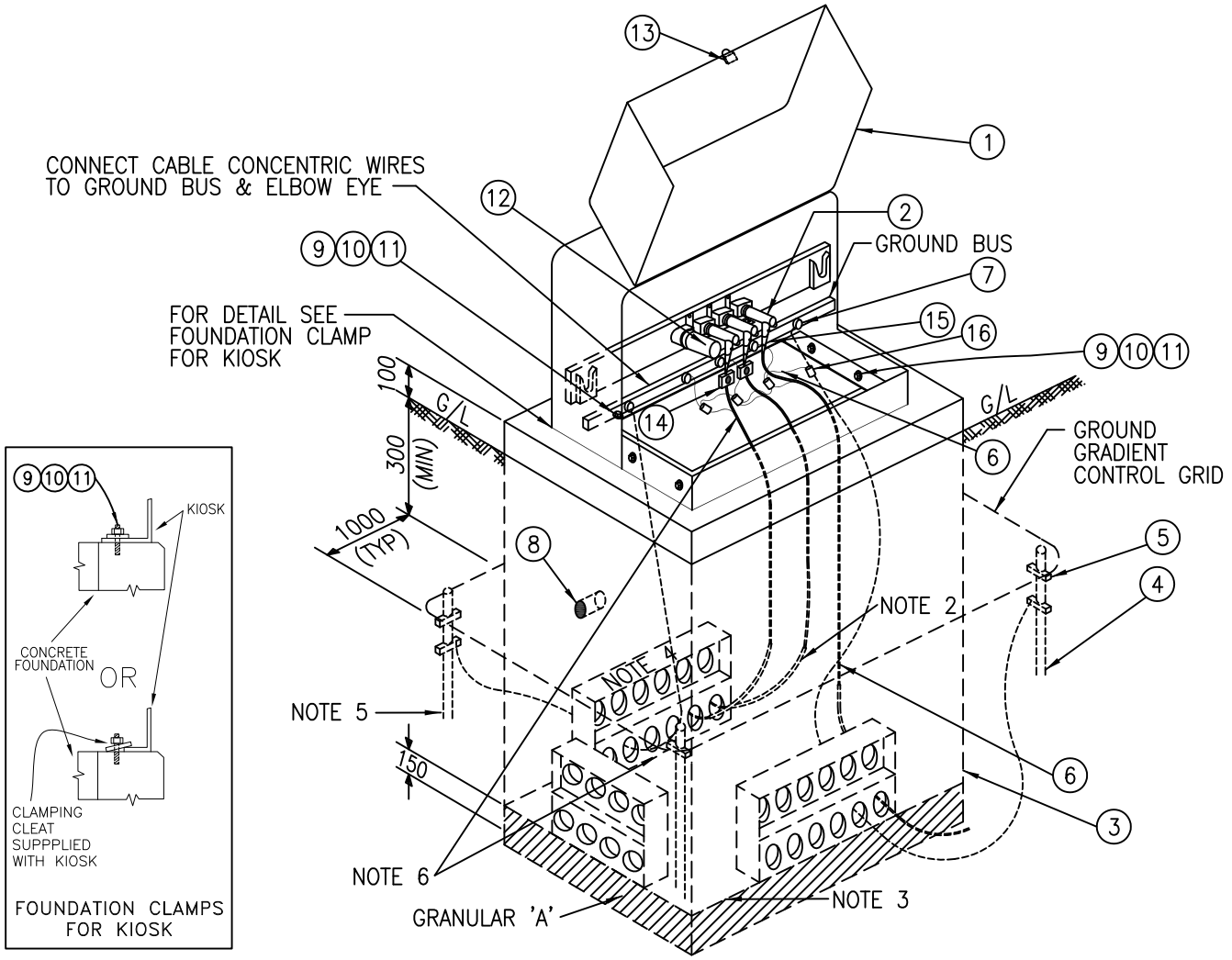
As a temporary measure, “Buck Phasing” (two cables of different phases with an open point) is permitted in kiosks. In such cases, one cable elbow shall be parked on the parking stand in the kiosk, and the other elbow with a different phase shall be installed on the junction bushing in the kiosk.

All temporary measures are to be clearly indicated on the drawings, along with the expected duration of the need, and shall be approved by the Hydro One Design Engineer. Clear signage and marking is to be placed within the switching kiosk to identify the non-standard situation. Phase designation shall be marked on the cable to indicate the phase to which the cables are connected.

In This Section

This section contains the following drawing:

Description	Dwg. #	Rev.
Single-Phase Pad-Mounted Kiosk Installation - Typical	DU-03-401	R2
Single-Phase Pad-Mounted Switchgear Installation - Typical	DU-03-402	R0



PART #	MM #	DESCRIPTION	QTY.
(1)	30011101 30011280 30011101 30010815	KIOSK – 1 PHASE, WITH BUSHING INSERTS	1
(2)*	30007476	ELBOW, LOADBREAK. 200A, 28kV	A/R
(3)	–	FOUNDATION, PRECAST	1
(4)	30014142	ROD, GROUND, 3/4" x 10', GALV.	4
(5)	30006646	CONNECTOR, GRD WEDGE, GROUND ROD TO COPPER WIRE	6
(6)	30014480	BARE COND, COPPER, #4	A/R
(7)	30006864	CONNECTOR, TERMINAL, COMP PAD, #4AWG	2
		A/R – AS REQUIRED	

PART #	MM #	DESCRIPTION	QTY.
(8)	30009051	COMPOUND DUCT SEALING	A/R
(9)	30001353	BOLT, GALV, HEX 1/2" x 1-3/4" LG	4
(10)	30001591	WASHER, ROUND, STEEL, 1/2" BOLT	4
(11)	30001605	WASHER LOCK SPRING, STEEL, 1/2" BOLT	4
(12)*	30007478	CAP INSULATING, 28 kV	A/R
(13)	30000346	PADLOCK	1
(14)*	30013112	FAULT INDICATOR, MECHANICAL TYPE	A/R
(15)	30006431	CONNECTOR, TERM COMP PAD FOR C.N. WIRES (2/0 AL CABLE).	A/R
(16)	30006154	CONNECTOR, TAP, BOLTED	A/R

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. USE SHORT PIECES OF POLY PIPE OR DISCARDED CABLE JACKETS TO PROTECT CABLE FROM RUBBING AGAINST THE ROUGH SURFACE OF CONCRETE FOUNDATION.
3. 150mm THICK LAYER OF CLASS 'A' GRANULAR MATERIAL, COMPACTED & LEVELLED BEFORE INSTALLATION OF FOUNDATION.
4. CABLES SHOULD ENTER THE FOUNDATION THROUGH THE LOWER OPENINGS AS SHOWN, FROM ANY SUITABLE SIDE.
5. FOR DETAILS OF GROUNDING, SEE DU-03-211. FOR INSULATED BUSHING CAP DETAILS, SEE DU-03-301 & FOR FOUNDATION INSTALLATION SEE DU-03-210 & SECTION 9.
6. LEAVE SUFFICIENT SLACK TO ALLOW ANY LOADBREAK ELBOW TO BE MOVED TO A PARKING POSITION.
7. PART #'s MARKED WITH '*' ARE SUPPLIED AND INSTALLED BY HYDRO ONE.
8. GROUND BUS IS EQUIPPED WITH SI-BR BOLTS/NUTS/WASHERS.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

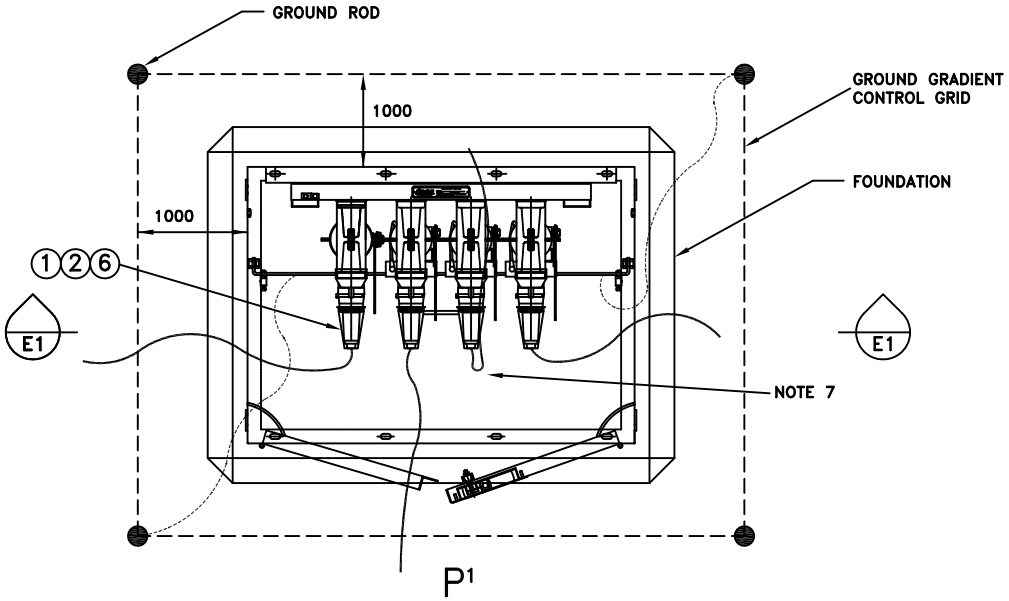
Rev. No.	Issue Date	Revision	Dwn	Approved By
02	NOV 2011	MM# & PARTS ADDED, NOTE 8 ADDED, 4 GROUND RODS & GROUNDING	WB / PC	* *
			Chk	Date

hydro one **Hydro One Networks Inc.**

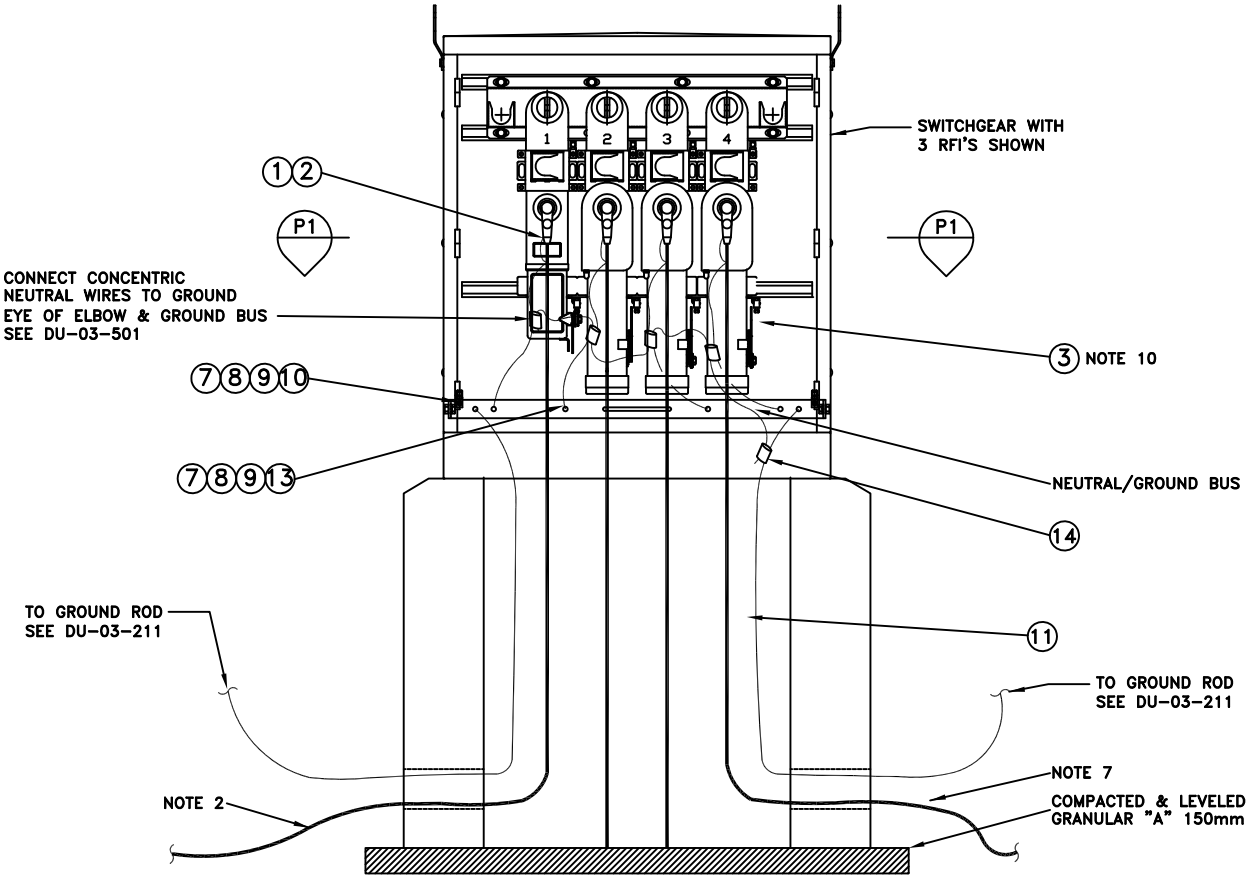
Drawn:	Approved:	Date:
W. BURDEN	*	NOV.15,2011

SINGLE-PHASE PAD-MOUNTED
KIOSK INSTALLATION - TYPICAL

Dwg. No. DU-03-401 Rev. 02



P1



E1

Rev. No.	Issue Date	Revision	Dwn	Approved By Date
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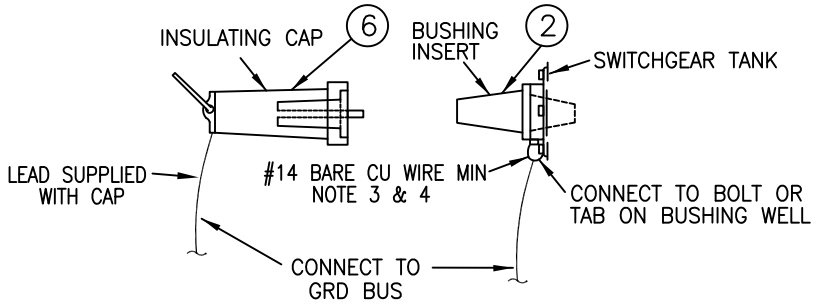
*	* *	* *	*	*

hydro one **Hydro One Networks Inc.**

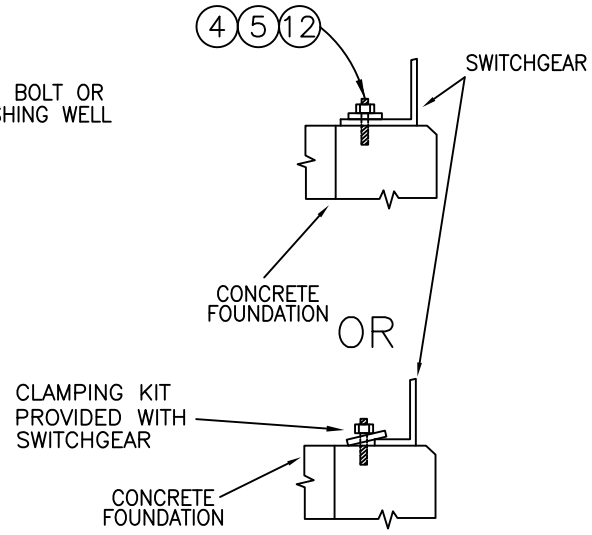
Drawn:	Approved:	Date:
W. BURDEN	*	NOV.15,2011

SINGLE-PHASE PAD-MOUNTED SWITCHGEAR INSTALLATION AND CONNECTIONS - TYPICAL

Dwg. No. DU-03-402 SH. 1 of 2 Rev. 00



GROUNDING OF INSULATING CAP AND/OR BUSHING INSERT



FOUNDATION CLAMPS FOR SWITCHGEAR

NOTES

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. USE SHORT PIECES OF POLY PIPE OR DISCARDED CABLE JACKETS TO PROTECT CABLE FROM RUBBING AGAINST THE ROUGH SURFACE OF CONCRETE FOUNDATION.
3. COVER ANY UNUSED BUSHING INSERTS WITH AN INSULATING CAP AND CONNECT IT TO GROUND.
4. USE CONCENTRIC NEUTRAL STRAND FROM DISCARDED SECTION U/G CABLE.
5. FOR FOUNDATION DETAILS SEE DU–03–210 & SECTION 9.
6. FOR GROUNDING DETAILS SEE DU–03–211.
7. DO NOT BEND CABLES MORE THAN THE PERMISSIBLE MINIMUM BENDING RADIUS OF 10 X DIAMETER. LEAVE SLACK IN CABLE FOR EASE IN ELBOW OPERATION AND PARKING.
8. PART NUMBERS MARKED WITH " * " ARE SUPPLIED BY HYDRO ONE.
9. ELBOW, BUSHING INSERT AND CAP TO MATCH SYSTEM VOLTAGE AND CABLE SIZE.
10. INSTALL FAULT INDICATORS (FCI) ON OUT GOING (TAP) SIDES, AS PER MANUFACTURERS INSTRUCTIONS. CABLES CONNECTED TO RFI DO NOT REQUIRE FAULT INDICATOR.
11. CABLES AND GROUND WIRE CAN ENTER THE FOUNDATION FROM ANY SUITABLE SIDE.

PART #	MM#	DESCRIPTION	QTY.	PART #	MM#	DESCRIPTION	QTY.
1 *	–	ELBOW, 200A LOADBREAK	A/R	8	30001499	SILICON BRONZE, 1/2" NUT	6
2 *	–	BUSHING UGRD, INSERT, LOADBREAK	A/R	9	30001681	SILICON BRONZE, 1/2" DIA. WASHER	6
3 *	30013112	FAULT INDICATOR, MECHANICAL TYPE (NOT SHOWN)	A/R	10	30006864	CONNECTOR, TERM COMP. PAD #4 AWG	2
4	30001353	BOLT, HEX HEAD GALV GR2, 1/2" DIA, 1–3/4" LG	8	11	30014480	BARE COND. COPPER #4	A/R
5	30001605	WASHER, LOCK HELICAL SPRING, 1/2" BOLT,	8	12	30001591	WASHER, ROUND, STEEL, 1/2" BOLT	8
6 *	–	CAP UNDERGROUND, INSULATING	A/R	13	30006431	CONNECTOR, TERM COMP PAD, FOR C.N. WIRES (2/0 AL CABLE), COMP.	A/R
7	30001184	SILICON BRONZE BOLT HEX HEAD 1/2" DIA., 1–1/2" LG	6	14	30006154	CONN. TAP BOLTED, COND. TO COND.	5

REFERENCES

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	* *	* *	*	*		*
00	* *	* *	*	*		*

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	*	NOV.15,2011

SINGLE-PHASE PAD-MOUNTED SWITCHGEAR INSTALLATION AND CONNECTIONS - TYPICAL

Dwg. No. DU-03-402 SH. 2 of 2 Rev. 00

SUB-SECTION 3C-5
EQUIPMENT PRIMARY TERMINATIONS & LABELING

Sub-Section 3C-5
Equipment Primary Terminations and Labeling

General

This section applies to the primary cable terminations installed within pad-mounted equipment.

Elbows and Bushings

While preparing the elbow terminations, adequate slack length of cables shall be kept inside the equipment foundation to prevent strain on the terminations or cables during load break elbow operations and its parking. See DU-03-301 and DU-03-401.

Hydro One supplies and installs the load break elbows, bushing inserts and insulating caps.

For use of arresters within equipment, refer to Table 2 in Design Guide 3D and the drawing DU-03-502.

Identification and Marking

All primary cable ends shall be provided with temporary (but clear) identification, by the subdivision constructor, showing the source location number as per DU-03-501.

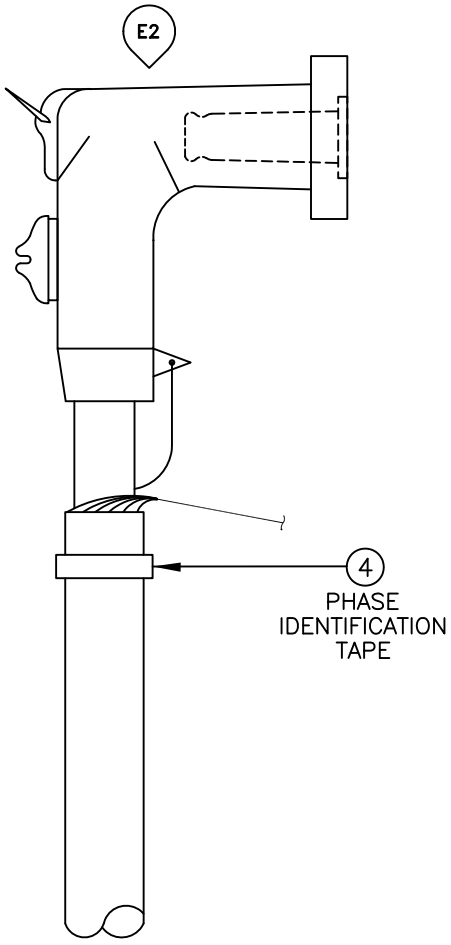
Additionally, within pad-mounted equipment, the number 1 is marked on the incoming (source side) cable, and numbers 2, 3, 4, etc. are marked on the outgoing/tap (load side) cables.

Hydro One supplies and installs the permanent identification on cable ends.

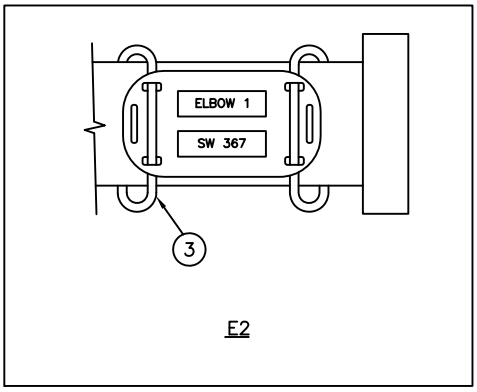
In This Section

This section contains the following drawing:

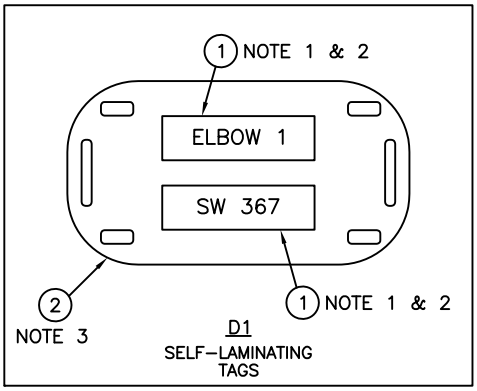
Description	Dwg. #	Rev.
Identification Markers for Underground Primary Cable	DU-03-501	R3
Surge Arrester on Pad-Mounted Equipment	DU-03-502	R0



E1



E2



D1
SELF–LAMINATING
TAGS

IDENTIFICATION OF PRIMARY CABLES NEAR LOAD BREAK ELBOWS

PART #	MM #	DESCRIPTION	QTY.
1	30010060	TAPE, DYMO, 1/2" PLASTIC – BLUE	
2	30027684	SELF–LAMINATING TAG – YELLOW	
3	30007873	CABLE TIE	
4	30010073	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE	
	30010074	SAME––WHITE	
	30010072	SAME––BLUE	

NOTES:
1. THE ELBOW NUMBER DENOTES THE INCOMING (No. 1) AND OUTGOING (No. 2) CABLES.
2. SEPARATE PLASTIC LABELS ARE USED TO RECORD THE ELBOW NUMBER AND SOURCE LOCATION NUMBER.
3. PLASTIC LABELS ARE PLACED IN THE ENVELOPE OF THE TAG BEFORE SECURING THE TAG TO THE PRIMARY CABLE.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 3C–1 – GENERAL
SECTION 3C–2 – CIVIL CONSTRUCTION
SECTION 16 – MATERIALS

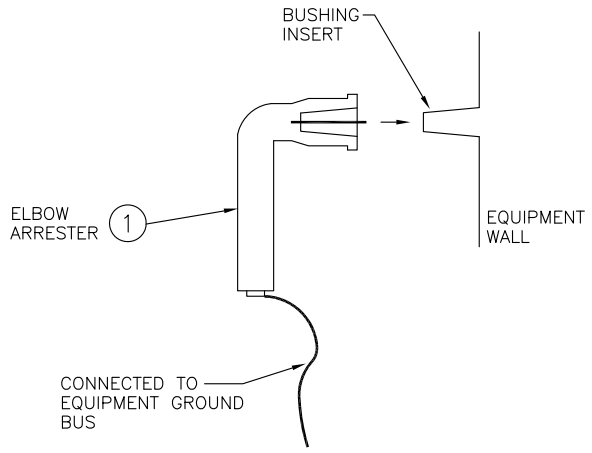
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
03	NOV 2011	MM# ADDED *	WB / PC	
02	OCT 2010	REVISIONS TO MAIN FIGURE NOTES AND PARTS LIST	PC	
01	SEP06 2006	GENERAL REVISIONS, WAS DU–03–601	AM / DP	D.PARIKH 09/26/06

hydro one **Hydro One Networks Inc.**

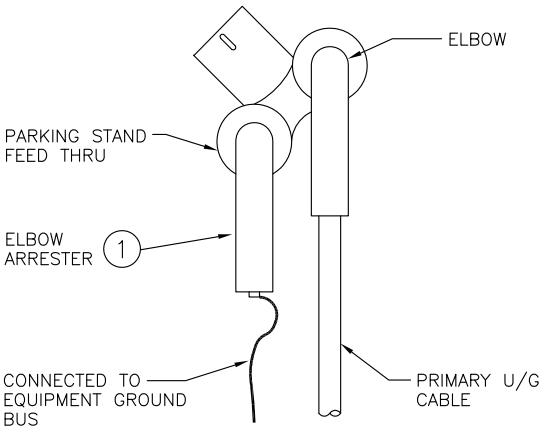
Drawn:	Approved:	Date:
W. BURDEN	*	NOV.15,2011

IDENTIFICATION MARKERS FOR UNDERGROUND PRIMARY CABLE

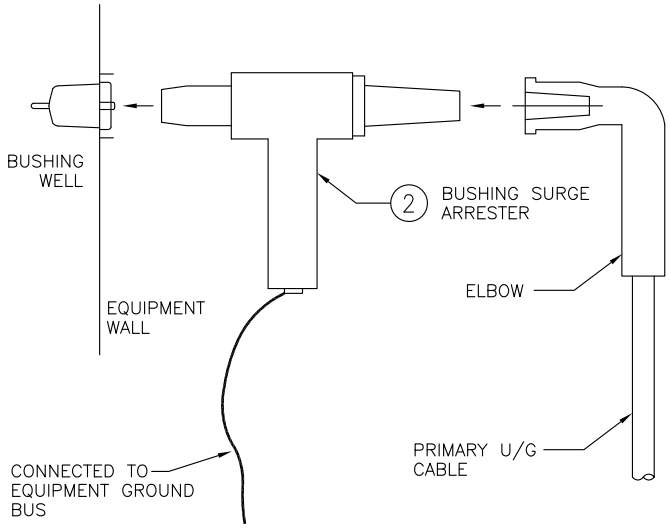
Dwg. No. DU-03-501 Rev. 03



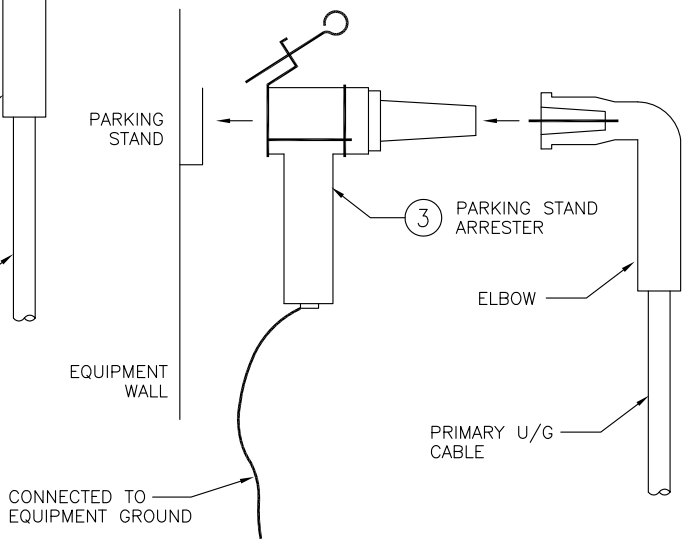
ELBOW ARRESTER



ELBOW ARRESTER



BUSHING SURGE ARRESTER



PARKING STAND ARRESTER

PART #	MASTER MATERIAL #	DESCRIPTION	QTY.
1	30005598	ARRESTER DIST.–21kV–17kV MCOV–ELBOW	–
2	30005599	ARRESTER DIST.–21kV–17kV MCOV–BUSHING	–
3	30005604	ARRESTER DIST.–21kV–17kV MCOV–PK. STD.	–
	30009905	ARRESTER DIST.–6kV–5.1kV MCOV–PK. STD.	–

NOTES:

1. FOR APPLICATION OF ARRESTER, REFER TO SECTION 3D & 4D.

REFERENCES

SECTION 3D – DESIGN GUIDE
SECTION 3C – CONSTRUCTION GUIDE
SECTION 4D – DESIGN GUIDE
SECTION 4C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
*	* *	* *	* / *	* *

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
P.CIARMOLI	*	AUG.22,2011

SURGE ARRESTER ON PAD-MOUNTED EQUIPMENT

Dwg. No. DU-03-502 Rev. 00

SUB-SECTION 3C-6
TRANSFORMER SECONDARY TERMINATIONS & LABELING

Sub-Section 3C-6
Transformer Secondary Terminations and Labeling

Terminations in Pad Mounted Transformer

For details of secondary cable terminations in pad-mounted transformers see DU-03-601.

Identification and Marking

All secondary cables shall be provided with temporary (but clear) identification at both ends, by the subdivision constructor, as per DU-03-602. Hydro One will install the permanent identification on cable ends. If the municipal (911) address is available, then this shall also be marked on the secondary cables.

Stray Voltage Installation

Drawing DU-03-603 provides details of how a stray voltage mitigation device is installed and connected to the padmount transformer. This installation may occasionally be required if there are stray voltage complaints from customers fed from a particular padmount transformer.

In This Section

This section contains the following drawings:

Description	Dwg. #	Rev.
Secondary Cable Terminations at Single-Phase Pad- Mounted Transformers	DU-03-601	R2
Identification Markers for Underground Secondary Cables	DU-03-602	R3
Stray Voltage Installation for Pad-Mount Transformer	DU-03-603	R1

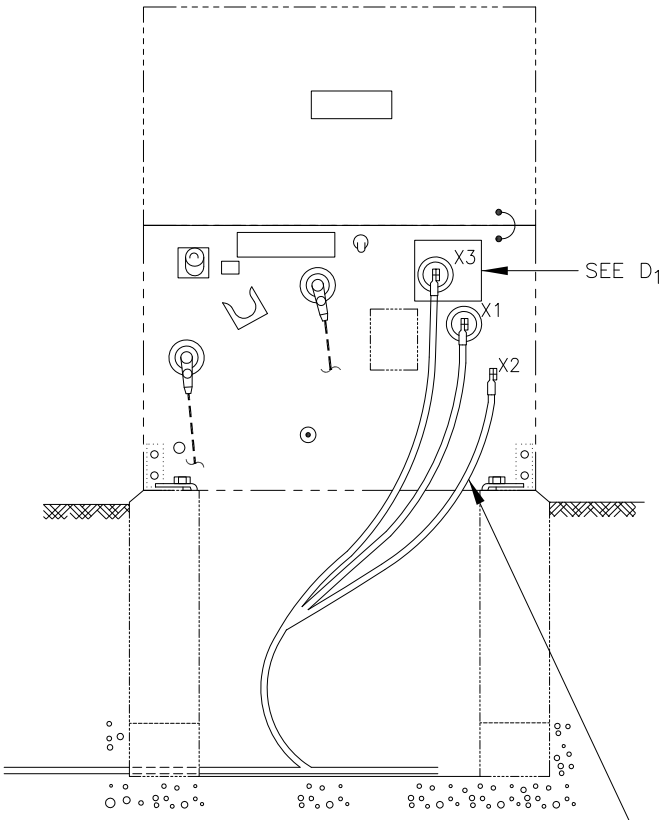
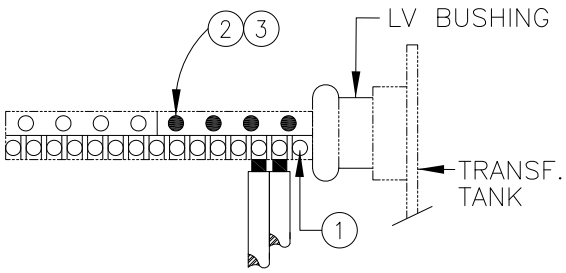
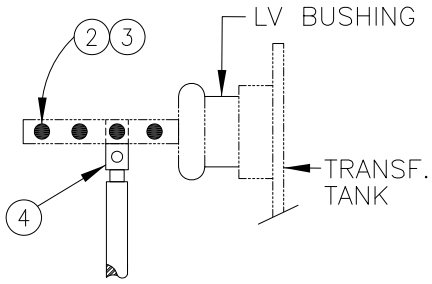


FIG. 1



CONNECTION OF SECONDARY CABLES UP TO 250MCM



CONNECTION OF 500MCM SECONDARY CABLE

D_1

PART #	MM #	DESCRIPTION	QTY.
(1)	30013232	CONN BLOCK, TAP BLTD, 14 POSN	1
(2)	30001243	BOLT, HEX GALV, 3/8" DIA, 1-1/2" LG	4
(3)	30001628	WASHER, LOCK SPRING, 3/8" BOLT, GALV	4
(4)	30007239	CONN. TERM. BOLTED, 4/0 to 500KCMIL	4

NOTE:
1. SECONDARY CABLE CORES ARE IDENTIFIED BY USE OF COLOURED JACKET
   NEUTRAL: (X2)-WHITE
   PHASES: (X1)-RED
   (X3)-BLACK

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

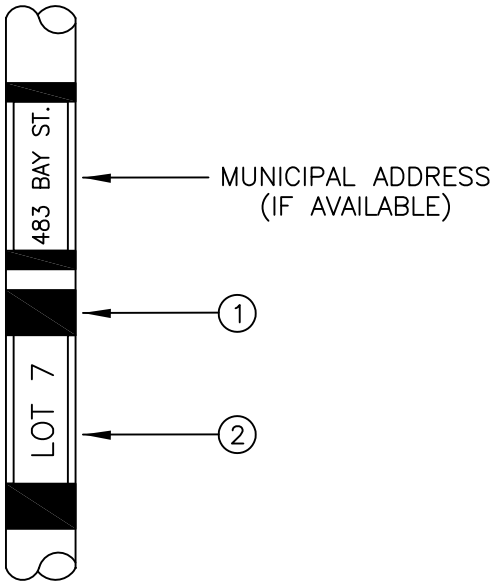
Rev. No.	Issue Date	Revision	Dwn	Approved By / Date
02	OCT 2011	MM# ADDED *	WB / PC	
01	SEP06 2006	GENERAL REVISIONS, WAS DU-03-501	AM / DP	D.PARIKH 09/26/06

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	*	OCT. 28, 2011

SECONDARY CABLE TERMINATIONS
AT SINGLE-PHASE PAD-MOUNTED TRANSFORMERS

Dwg. No. DU-03-601 Rev. 02



IDENTIFICATION OF SECONDARY CABLES AT TRANSFORMER END

PART #	MM #	DESCRIPTION	QTY.
1	30008340	TAPE ELEC, 3/4" PVC BLACK	
2	30010060	TAPE, DYMO, EMBOSSING 12mm BLUE	

NOTE:
1. THE HOUSE SIDE END OF SECONDARY CABLE NEED NOT HAVE PERMANENT IDENTIFICATION MARKINGS. HOWEVER, IT SHALL STILL BE TEMPORARILY LABELLED AS ABOVE.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
03	NOV 2011	MM# ADDED *	WB / PC	
01	SEP06 2006	GENERAL REVISIONS, WAS DU–03–502	AM / DP	D.PARIKH 09/26/06

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	*	NOV.15,2011

IDENTIFICATION MARKERS FOR UNDERGROUND SECONDARY CABLE

Dwg. No. DU-03-602 Rev. 03

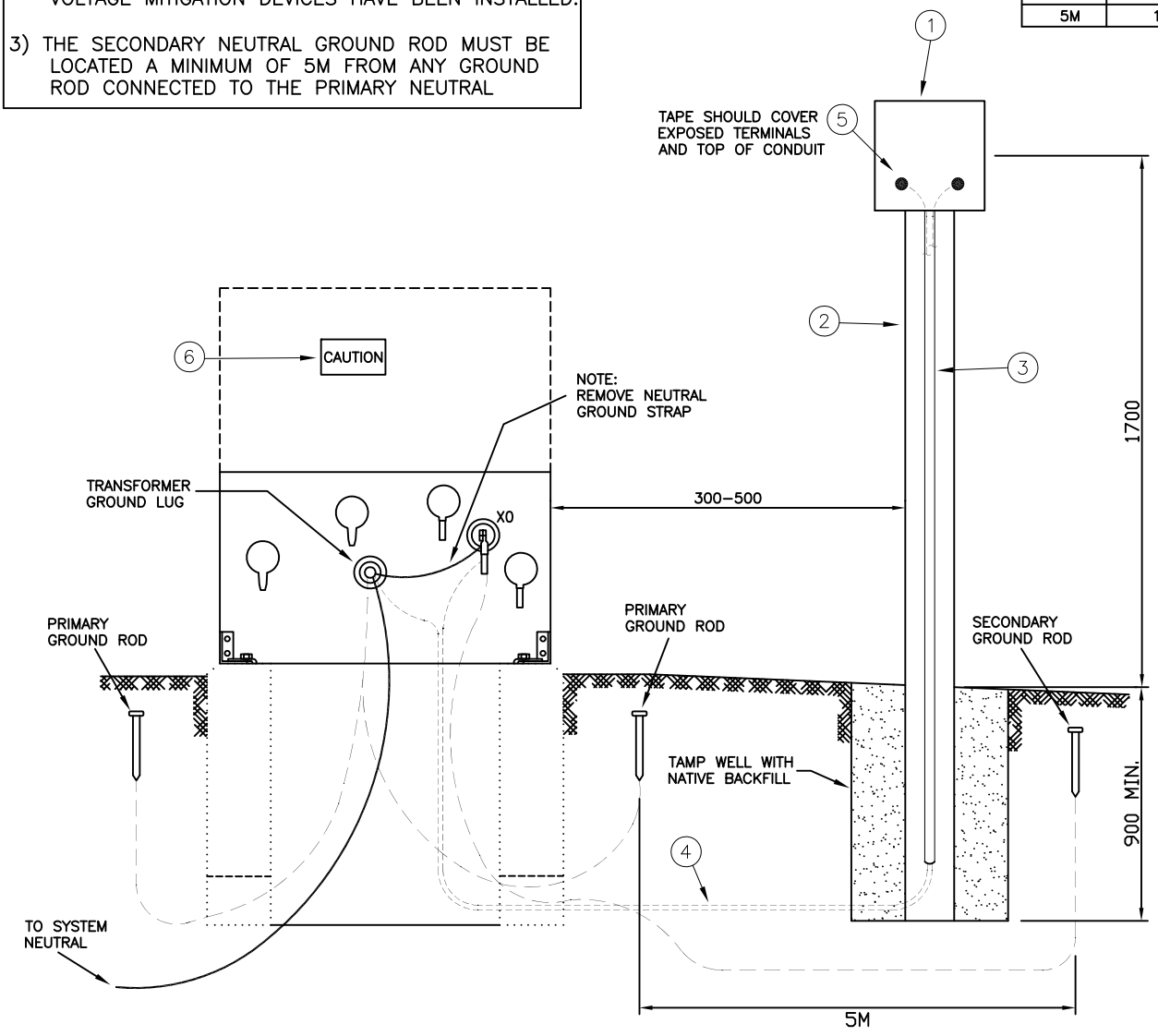
NOTES

1) ALL DIMENSIONS IN MM UNLESS STATED OTHERWISE.

2) REFER TO HODS FOR INSTRUCTIONS REGARDING WORKING ON TRANSFORMER POLES WHERE STRAY VOLTAGE MITIGATION DEVICES HAVE BEEN INSTALLED.

3) THE SECONDARY NEUTRAL GROUND ROD MUST BE LOCATED A MINIMUM OF 5M FROM ANY GROUND ROD CONNECTED TO THE PRIMARY NEUTRAL

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
300	12"
500	18"
900	3'–0"
1700	5'–6"
5M	15'



PART #	MM #	DESCRIPTION	QTY.
1	30021907	NEUTRAL ISOLATOR	1
2	AS NEEDED	LUMBER, 4"X8"X10'	1
3	30007538	CONDUIT, PVC, 3/4"	1
4	30005890	INSULATED CABLE, #4 CU	—
5	30008386	TAPE ELECT., SELF AMALGAMATING	—
6	20002317	CAUTION STICKER	1

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
01	NOV 2011	ADDED MM #'S	SO / *	* / *

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV. 03, 2011

STRAY VOLTAGE INSTALLATION FOR PAD-MOUNT TRANSFORMER

Dwg. No. DU-03-603 Rev. 01

11/03/2011

SECTION 4
THREE PHASE DISTRIBUTION
(INDUSTRIAL & COMMERCIAL SUBDIVISIONS)

Section 4

Three-Phase Distribution - Industrial and Commercial Subdivisions

In this Section

This Section outlines the design and construction standards for specifying and installing the typical three-phase underground distribution network in industrial and commercial subdivisions, operating at three-phase primary voltages up to 27.6 kV. This Section is divided into two main sub-sections.

Sub-section 4D covers design related matters and sub-section 4C covers construction related matters.

Topic	Section #	Rev Date
Design Guide - Three-phase Distribution, Industrial and Commercial Subdivisions	4D	Nov 2011
Construction Guide - Three-phase Distribution, Industrial and Commercial Subdivisions	4C	Nov 2011

SUB-SECTION 4C-3
THREE PHASE PAD-MOUNTED TRANSFORMERS

Sub-Section 4C-3
Three-Phase Pad-Mounted Transformers

Installation	Three-phase pad-mounted transformers shall be installed, and connected, in accordance with drawing DU-04-301. Transformers shall be placed on foundations that are installed as per Sub-Section 4C-2 and drawing DU-03-210. The location of transformers and foundations shall be as specified in Sub-Section 4C-2.
Elbows and Bushings	Adequate length of cables (minimum 3 m) shall be left inside the transformer foundation for cable termination and to facilitate ease in elbow operations. Unused transformer bushings shall be protected by an appropriate insulating cap. See DU-04-301 for details. Hydro One supplies and installs the load break elbows, bushing inserts and insulating caps.
Identification and Labels	Approved labels/markers, as outlined in DU-04-302, shall be used to identify transformers. The labels/markers shall include the transformer location number, transformer rating, the caution signs and the danger signs. Hydro One supplies and installs the labels and markers.
Fault Indicators	Faulted circuit indicators are to be installed on the cable that is connected to the H1B, H2B and H3B terminals of every Hydro One owned transformer. Faulted circuit indicator installation shall be as per drawings DU-04-301. Application criteria for different types of fault indicator are specified in Sub-Section 4D. Hydro One supplies and installs the fault indicators.
Lightning Arresters	Lightning arresters, for surge protection of transformers and primary cables connected to transformers, are to be applied as specified in Sub-Section 4D. Hydro One supplies and installs the arresters.
Grounding	Transformers shall be connected to their ground grid as per drawing DU-04-301, with a minimum #4 AWG bare copper wire and approved ground connectors. For ground grid details see DU-03-211. The final connection of ground grid wires to the transformer H0 and tank ground terminals, and to cable neutral wires, is done by Hydro One.

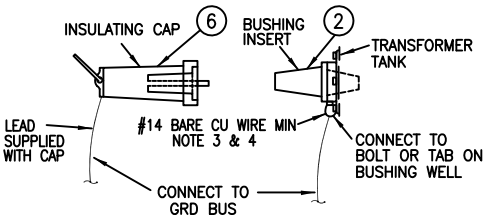
Bonding

All above ground metallic parts of other equipment (such as the metallic street light disconnect or bollards) located within 3 m of the transformer ground grid, shall be bonded to the ground rod of this grid. Bonding shall be done with a minimum #4 AWG bare copper wire, and cad-weld or approved ground connectors. See DU-03-212 and DU-03-214 for typical details of bonding.

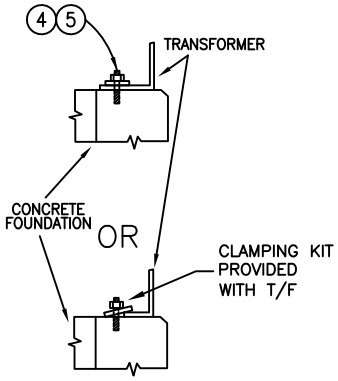
In This Section

This section contains the following drawings:

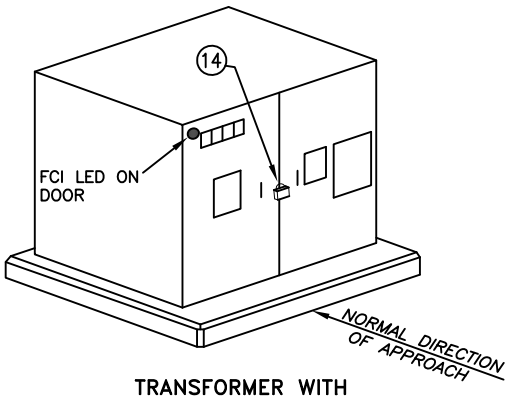
Description	Dwg. #	Rev.
Three-Phase Pad-Mounted Transformer Installation and Connections	DU-04-301	R1
Signs and Markers on Three-Phase Pad-Mounted Equipment	DU-04-302	R1



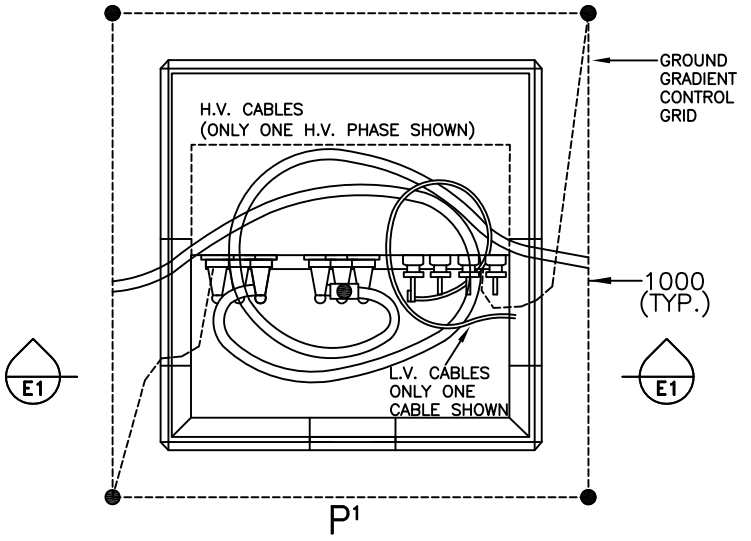
GROUNDING OF INSULATING CAP AND/OR BUSHING INSERT

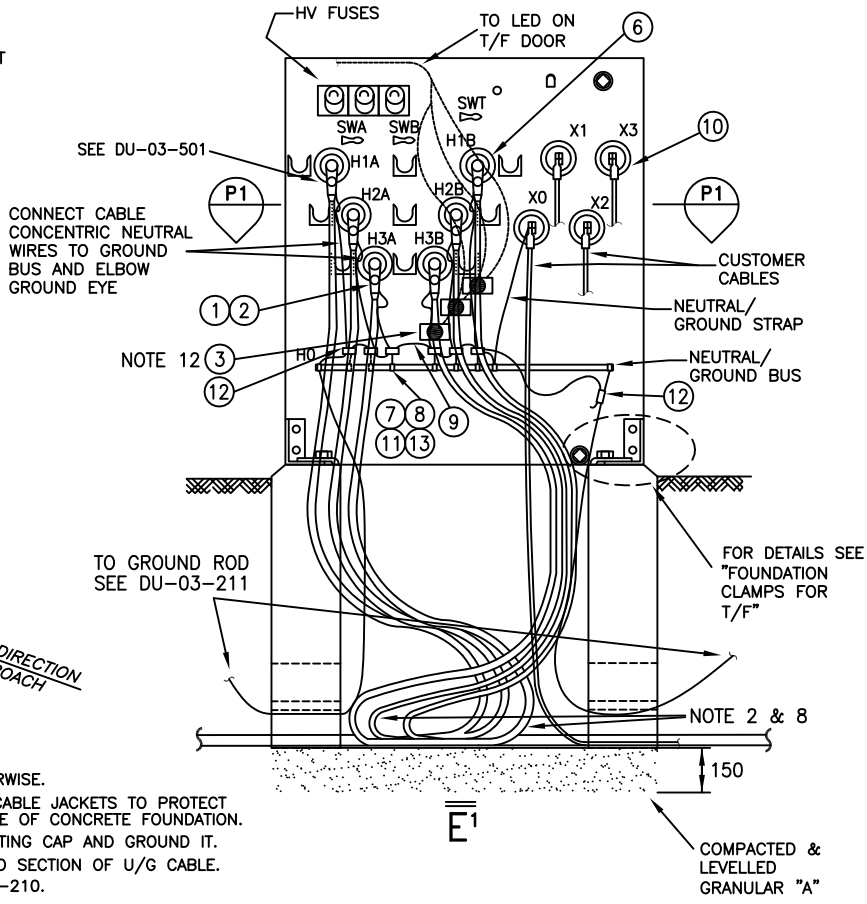


FOUNDATION CLAMPS FOR TRANSFORMER



TRANSFORMER WITH DOORS CLOSED





NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. USE SHORT PIECES OF POLY PIPE OR DISCARDED CABLE JACKETS TO PROTECT CABLE FROM RUBBING AGAINST THE ROUGH SURFACE OF CONCRETE FOUNDATION.
3. COVER ANY UNUSED BUSHING INSERTS WITH INSULATING CAP AND GROUND IT.
4. USE CONCENTRIC NEUTRAL STRAND FROM DISCARDED SECTION OF U/G CABLE.
5. FOR FOUNDATION INSTALLATION DETAILS SEE DU-03-210.
6. FOR GROUNDING DETAILS SEE DU-03-211.
7. FOR SECONDARY CONNECTION DETAILS SEE DU-04-601.
8. DO NOT BEND CABLES MORE THAN THE PERMISSIBLE MINIMUM BENDING RADIUS 10 x DIAMETER. LEAVE SLACK IN CABLE TO PERMIT EASE IN ELBOW OPERATION.
9. PART #'s MARKED WITH '*' ARE SUPPLIED & INSTALLED BY HYDRO ONE.
10. ELBOW, BUSHING INSERT & CAP TO MATCH THE SYSTEM VOLTAGE & CABLE SIZE
11. LOOP FEED TRANSFORMER SHOWN IS TYPICAL ONLY. RADIAL FEED MAY ALSO BE USED
12. INSTALL FAULT INDICATORS AS PER MANUFACTURER'S INSTRUCTIONS.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 4C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
01	NOV 2011	GENERAL REVISIONS, ADDED MM#, 4 RODS & GROUNDING DETAILS	SO / *	* *

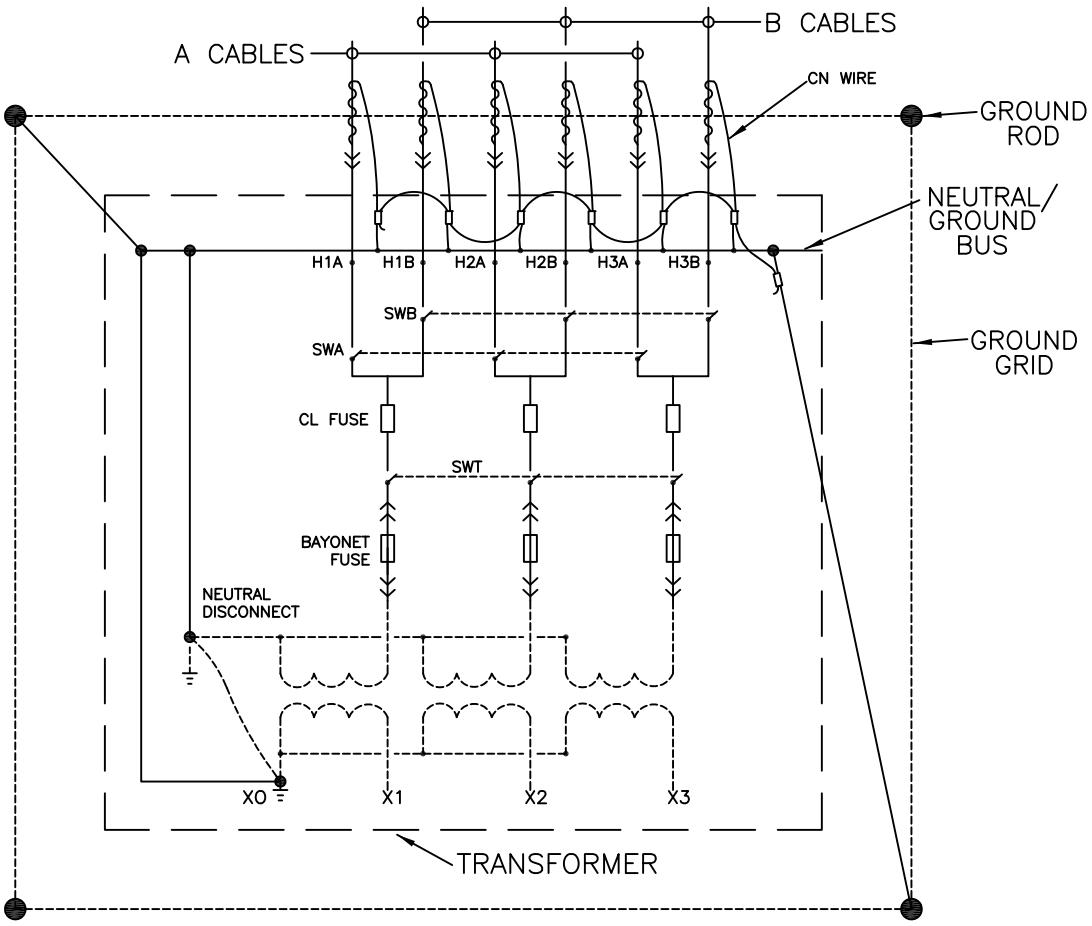
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV.15, 2011

THREE-PHASE PAD-MOUNTED TRANSFORMER INSTALLATION AND CONNECTIONS

Dwg. No. DU-04-301 SH. 1 of 2 Rev. 01

3ø, 2.4/4.16 TO 16/27.6kV SUPPLY



THREE LINE AND GROUNDING DIAGRAM

PART #	MM #	DESCRIPTION	QTY.	PART #	MM #	DESCRIPTION	QTY.
(1)*	30007476	ELBOW, LOADBREAK	6	(8)	30006431	CONNECTOR, COMPRESSION, FOR CN WIRES 2/0 CABLE	6
(2)*	30007479	BUSHING UGRD, INSERT, LOADBREAK	6	(9)	30014480	BARE COND, COPPER, 4AWG	3m
(3)*	30022812	FAULT INDICATOR, LED TYPE (3 FI, 1 LED)	3	(10)	CUSTOMER SUPPLIED	CONNECTOR, TERM, COMP PAD, 2 HOLE, M12 STUD C/W BOLT, NUT & WASHER	4
(4)	30001353	BOLT, HEX HEAD GALV GR2, 1/2" DIA, 1-3/4" LG	4	(11)	30001499	NUT, 1/2" SI-BR	8
(5)	30001605	WASHER, LOCK HELICAL SPRING, 1/2" BOLT	4	(12)	30006154	CONNECTOR, TAP, BLTD, COND TO COND	7
(6)	30007478	CAP UGRD, INSULATING, 28Kv	3 MAX	(13)	30001184	BOLT, 1/2" S-BR	8
(7)	30001681	WASHER, ROUND, 1/2" SI-BR	8	(14)	30000346	PADLOCK	1

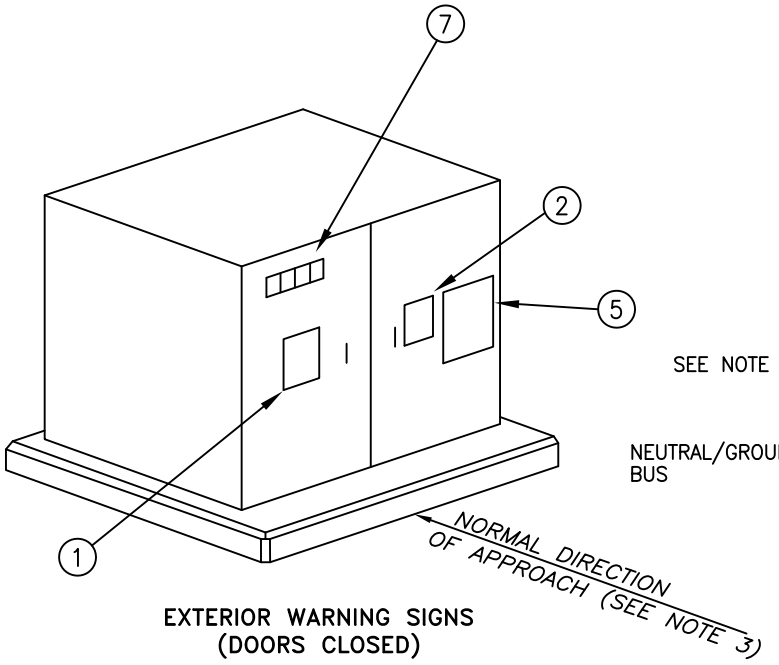
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
01	NOV 2011	GENERAL REVISIONS, ADDED MM#, 4 RODS & GROUNDING DETAILS	SO *	* *

hydro one **Hydro One Networks Inc.**

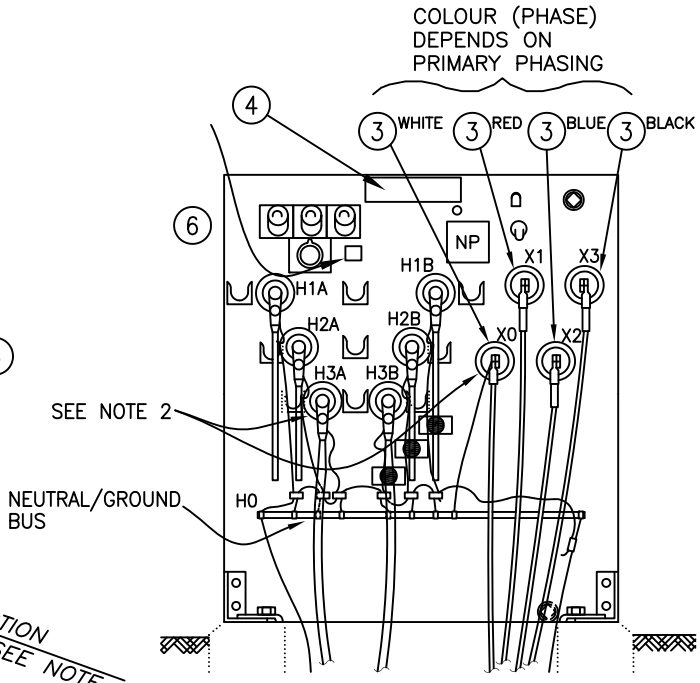
Drawn:	Approved:	Date:
S.OORT	*	NOV.15, 2011

THREE-PHASE PAD-MOUNTED TRANSFORMER INSTALLATION AND CONNECTIONS

Dwg. No. DU-04-301 SH. 2 of 2 Rev. 01



EXTERIOR WARNING SIGNS
(DOORS CLOSED)



INTERIOR SIGNS
(DOORS OPEN)

PART #	MM #	DESCRIPTION	QTY.	REMARKS
(1)	20002130	VISUAL SIGN, "DANGER HIGH VOLTAGE"	1 MIN	LOCATE ON MOST NOTICABLE SIDE(S). REQUIRED ON ALL UNITS.
(2)	20002125	VISUAL SIGN "DANGER, DO NOT DIG OR DRIVE STAKES"	1 MIN	LOCATE ON MOST NOTICABLE SIDE(S). REQUIRED ON ALL UNITS.
(3)	30010073 30008340 30010072 30010074	TAPE INSULATING, "RED PHASE" SAME--"BLACK PHASE" SAME--"BLUE PHASE" SAME--"WHITE PHASE"	1 MIN	
(4)	20001595	VISUAL SIGN, "CAUTION LOOP FEED"	1	USE FOR LOOP FEED CONNECTED TRANSFORMERS ONLY.
(5)	20002119	VISUAL SIGN, "DANGER, DO NOT OPEN YOU CAN BE HURT"	1	NORMALLY SUPPLIED BY TRANSFORMER MANUFACTURER. LOCATE ON MOST NOTICABLE SIDE(S). REQUIRED ON ALL UNITS.
(6)	20002182	VISUAL SIGN "DO NOT OPERATE FUSE...."	1	NORMALLY SUPPLIED BY TRANSFORMER MANUFACTURER, REQUIRED ON ALL UNITS SUPPLIED WITH DRY WELL CANISTERS.
(7)	20001563 to 20001571	VISUAL SIGN, "LOCATION NUMBER (No. 0 to 9)"	A/R	AS REQUIRED

NOTES:
1. TRANSFORMER SHOWN AS REFERENCE. THE SIGNS AND MARKERS SHOWN (EXCEPT PARTS (6)) SHALL ALSO BE PROVIDED ON KIOSK/SWITCHGEAR.
2. FOR IDENTIFICATION OF PRIMARY CABLES SEE DU-03-501.
3. IF DIRECTION OF APPROACH IS DIFFERENT THAN INDICATED, ADD LOCATION NUMBER (PART (7)) TO THAT SIDE ALSO.
4. UNLESS SPECIFIED OTHERWISE, ALL SIGNS & MARKERS ARE SUPPLIED AND INSTALLED BY HYDRO ONE.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 4C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
01	NOV 2011	ADDED MM #'S *	SO *	* *

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV. 15, 2011

SIGNS & MARKERS ON THREE-PHASE PAD-MOUNTED EQUIPMENT

Dwg. No. DU-04-302 Rev. 01

SUB-SECTION 4C-4
THREE PHASE PRIMARY SWITCHING DEVICES KIOSKS & SWITCHGEAR

Sub-Section 4C-4
Three-Phase Primary Switching Devices – Kiosks and Switchgear

Installation	Three-phase switching kiosks and switchgear shall be installed as shown on drawings DU-04-401 and DU-04-402. Switching equipment shall be placed on foundations which are installed as specified in Sub-Section 4C-2 and drawing DU-03-210. Location of switching equipment shall be as specified in Sub-Section 4C-2. For required foundation see section 9.
Elbows and Bushings	Adequate length of cables (minimum 3 m) shall be left inside the switching equipment foundation for cable termination and to facilitate ease in elbow operations. Unused equipment bushings shall be protected by an appropriate insulating cap. For details of insulating cap installation, see DU-04-301. Hydro One supplies and installs the load break elbows, bushing inserts and insulating cap.
Identification and Labels	Approved labels/markers as outlined in DU-04-302, shall be used to identify switching equipment. The labels/markers shall include the equipment location number, the caution signs and the danger signs. Hydro One supplies and installs the labels and markers.
Fault Indicators	Mechanical type faulted circuit indicators (FCI) are to be installed on the cables that are connected to all outgoing (tap) terminals of switching equipment. Application criteria for different types of FCI are specified in Sub-Section 4D. FCI installation shall be as per drawing DU-04-401 and DU-04-402. Hydro One supplies and installs the FCI.
Lightning Arresters	Lightning arresters, for surge protection of switching equipment and primary cables connected to such equipment, are to be installed as specified in Sub-Section 4D. This protection is not required if there is at least one three phase outgoing cable circuit from kiosk/switchgear. If kiosk/switchgear has only one three phase cable incoming circuit (for example temporary cables for a future extension of the subdivision) or only one single phase outgoing cable (for example for a street light transformer) then the arresters shall be used for the protection on unused phases. Hydro One supplies and installs the arresters.

Grounding

Switching equipment shall be connected to the ground grid as per drawing DU-04-401/DU-04-402, with minimum #4 AWG bare copper wire and approved ground connectors. For ground grid details see DU-03-211.

The final connection of ground grid wires to the switching equipment ground terminals/ground bus and cable concentric neutral wires is done by Hydro One.

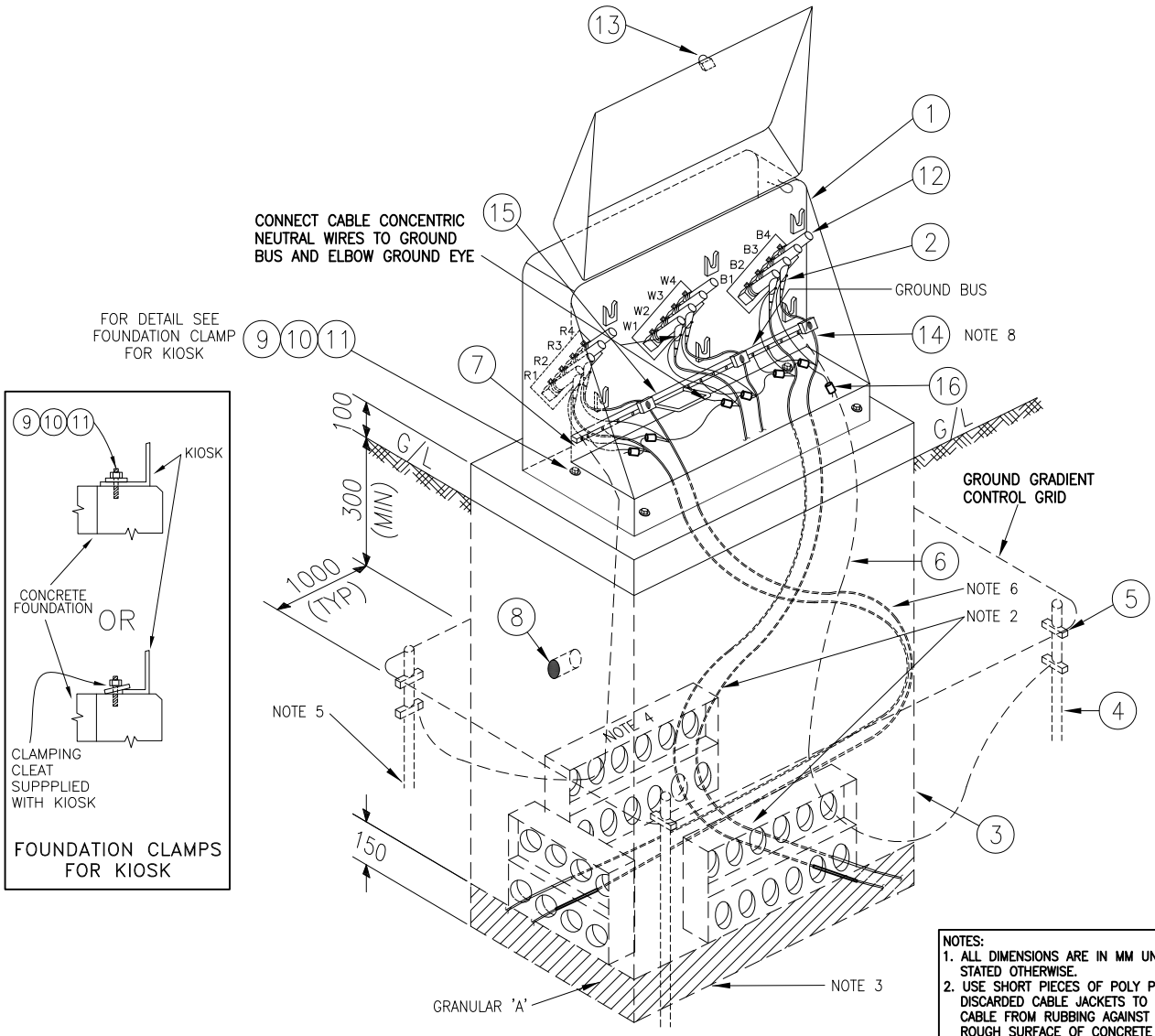
Bonding

All above ground metallic parts of other equipment (such as the metallic street light disconnect or bollards) located within 3 m of switching equipment ground grid, shall be bonded to this ground grid. Bonding shall be done with a minimum #4 AWG bare copper wire and a cad-weld or approved ground connectors. See DU-03-212 and DU-03-214 for typical details of bonding.

In This Section

This section contains the following drawing:

Description	Dwg. #	Rev.
Three-Phase Pad-Mounted Kiosk Installation - Typical	DU-04-401	R1
Three-Phase Pad-Mounted Switchgear Installation - Typical	DU-04-402	R1



REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 4C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

PART #	MM#	DESCRIPTION	QTY.
1	30011246 30011260 30014366 30010863	KIOSK, 3 PHASE,	1
2*	30007476	ELBOW, LOADBREAK. 200A, 28kV	A/R
3	–	FOUNDATION, PRECAST	1
4	30014142	ROD, GROUND, 3/4" x 10', GALV.	4
5	30006646	CONNECTOR, GRD WEDGE, GROUND ROD TO COPPER WIRE	6
6	30014480	BARE COND, COPPER, #4 AWG	A/R
7	30006864	CONNECTOR, TERMINAL, BOLTED PAD #4AWG	2
8	30009051	COMPOUND DUCT SEALING	A/R

PART #	MM#	DESCRIPTION	QTY.
9	30001353	BOLT, GALV, HEX 1/2" x 1-3/4" LG	4
10	30001591	WASHER, ROUND, STEEL, 1/2" BOLT	4
11	30001605	WASHER LOCK SPRING, STEEL, 1/2" BOLT	4
12*	30007478	CAP INSULATING	A/R
13	30000346	PADLOCK	1
14*	30013112	FAULT INDICATOR, MECHANICAL TYPE	A/R
15	30006431	CONNECTOR, TERM BOLTED PAD FOR C.N. WIRES (2/0 AL CABLE)	A/R
16	30006154	CONNECTOR, TAP, BOLTED	A/R
		A/R – AS REQUIRED	

NOTES:
1. ALL DIMENSIONS ARE IN MM UNLESS STATED OTHERWISE.
2. USE SHORT PIECES OF POLY PIPE OR DISCARDED CABLE JACKETS TO PROTECT CABLE FROM RUBBING AGAINST THE ROUGH SURFACE OF CONCRETE FOUNDATION.
3. 150MM THICK LAYER OF CLASS 'A' GRANULAR MATERIAL, COMPACTED AND LEVELLED BEFORE INSTALLATION OF FOUNDATION.
4. CABLES SHOULD ENTER THE FOUNDATION THROUGH THE LOWER OPENINGS AS SHOWN, FROM ANY SUITABLE SIDE.
5. FOR KIOSK GROUNDING DETAILS SEE DU-03-211. COVER ANY UNUSED BUSHING WITH INSULATED CAP AND GROUND THE CAP. FOR INSULATED BUSHING CAP AND ITS GROUNDING DETAILS SEE DU-04-301. FOR FOUNDATION INSTALLATION DETAILS SEE DU-03-210.
6. DO NOT BEND CABLES MORE THAN THE PERMISSIBLE MINIMUM BENDING RADIUS OF 10 x DIAMETER. LEAVE SLACK IN CABLE FOR EASE IN ELBOW OPERATION & PARKING.
7. PART #'S MARKED WITH '*' ARE SUPPLIED AND INSTALLED BY HYDRO ONE.
8. INSTALL FAULT INDICATORS AS PER MANUFACTURER'S INSTRUCTIONS.
9. SEE DU-04-302 FOR DANGER/CAUTION SIGNS.
10. GROUND BUS IS EQUIPPED WITH SI-BR BOLTS/NUTS/WASHERS.

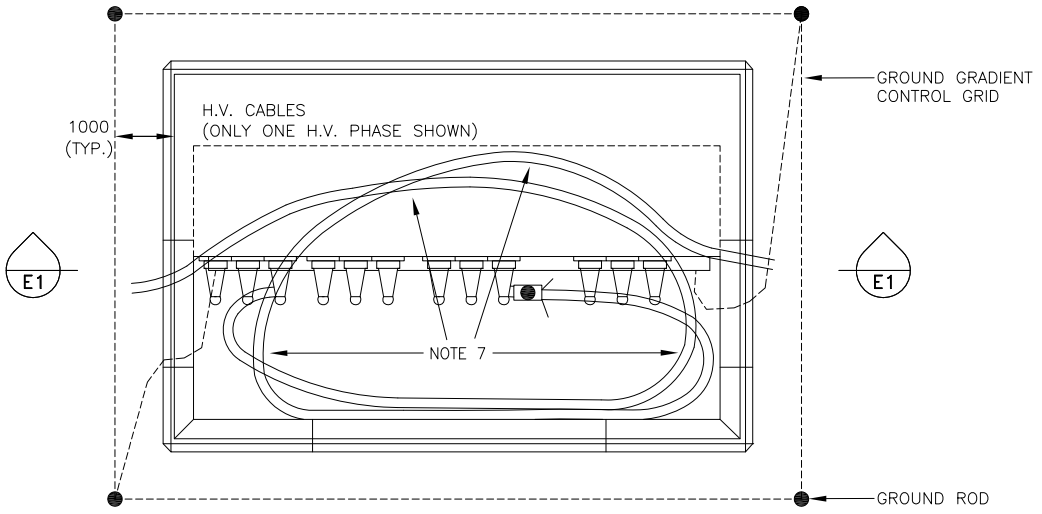
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
01	NOV 2011	MM# ADDED, NOTE 10 ADDED, 4 GROUND RODS & GROUNDING DETAILS	WB / PC	* *

hydro one **Hydro One Networks Inc.**

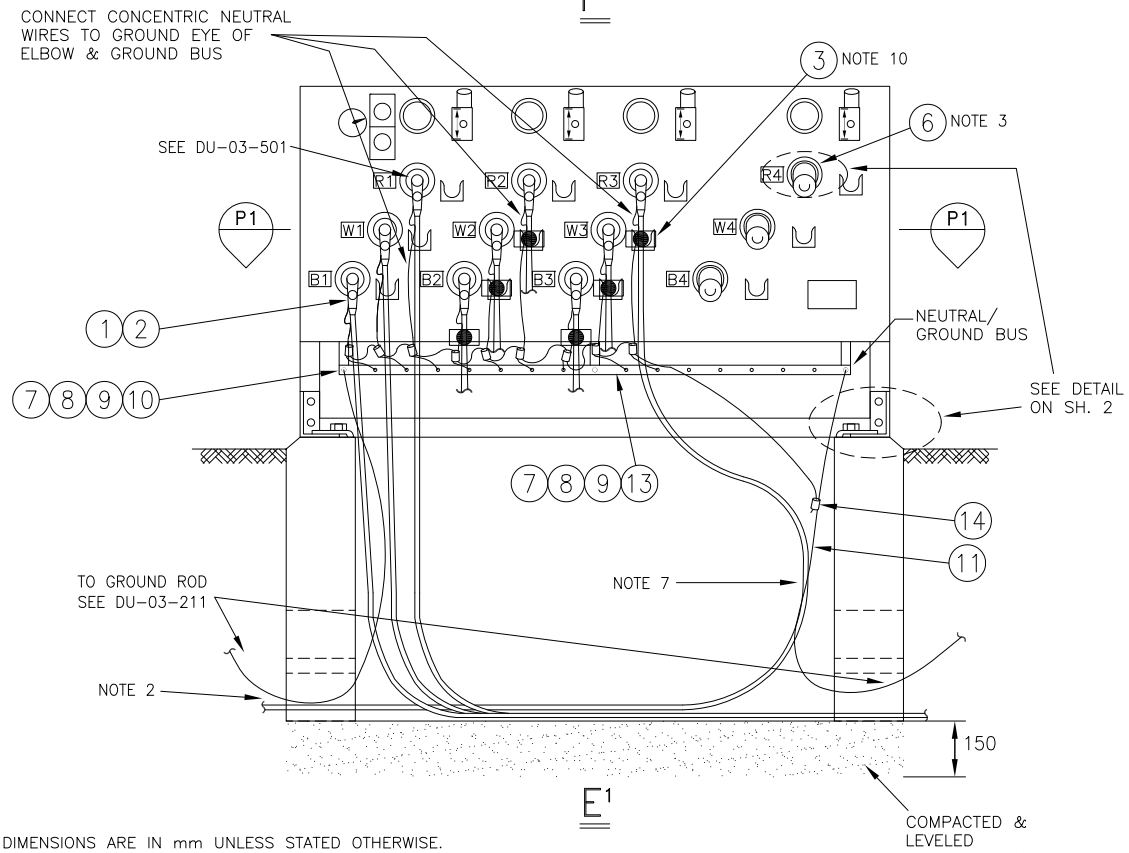
Drawn:	Approved:	Date:
W. BURDEN	D.PARIKH	NOV.15,2011

THREE-PHASE, PAD-MOUNTED KIOSK INSTALLATION - TYPICAL

Dwg. No. DU-04-401 Rev. 01



P1



E1

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. USE SHORT PIECES OF POLY PIPE OR DISCARDED CABLE JACKETS TO PROTECT CABLE FROM RUBBING AGAINST THE ROUGH SURFACE OF CONCRETE FOUNDATION.
3. COVER ANY UNUSED BUSHING INSERTS WITH INSULATING CAP AND GROUND IT.
4. USE CONCENTRIC NEUTRAL STRAND FROM DISCARDED SECTION OF U/G CABLE.
5. FOR FOUNDATION INSTALLATION DETAILS SEE DU-03-210.
6. FOR GROUNDING DETAILS SEE DU-03-211.
7. DO NOT BEND CABLES MORE THAN THE PERMISSIBLE MINIMUM BENDING RADIUS OF 10 x DIAMETER. LEAVE SLACK IN CABLE FOR EASE IN ELBOW OPERATION & PARKING.
8. PART #'s MARKED WITH '*' ARE SUPPLIED & INSTALLED BY HYDRO ONE.
9. ELBOW, BUSHING INSERT & CAP TO MATCH THE SYSTEM VOLTAGE & CABLE SIZE
10. INSTALL FAULT INDICATORS AS PER MANUFACTURER'S INSTRUCTIONS.
11. SEE DU-04-302 FOR DANGER/CAUTION SIGNS.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 4C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

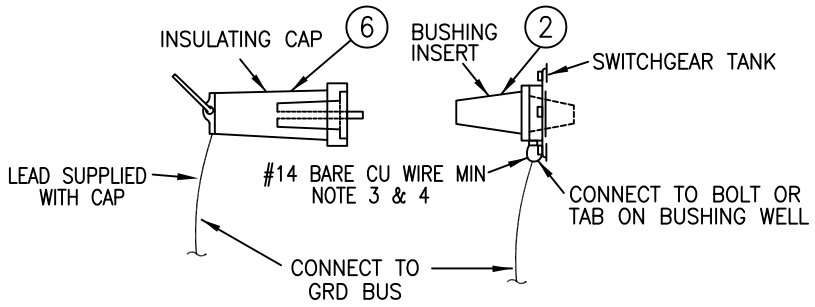
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
01	NOV 2011	4 GROUND RODS, GROUNDING DETAILS & MM# ADDED	WB / PC	* / *

hydro one **Hydro One Networks Inc.**

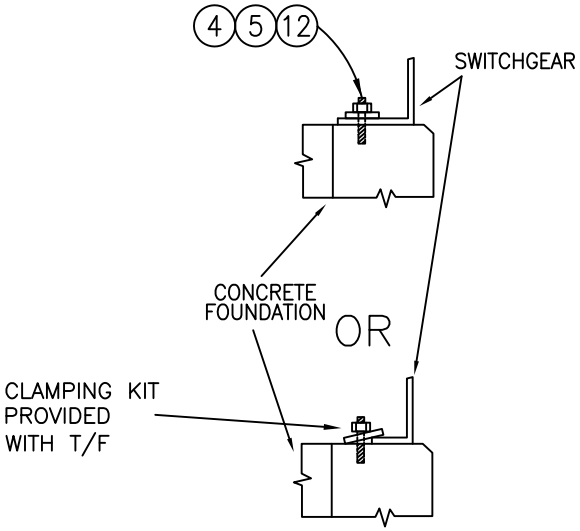
Drawn:	Approved:	Date:
W. BURDEN	D. PARIKH	NOV. 15, 2011

THREE-PHASE PAD-MOUNTED SWITCHGEAR
INSTALLATION AND CONNECTIONS - TYPICAL

Dwg. No. DU-04-402 SH.1 OF 2 Rev. 01



GROUNDING OF INSULATING CAP AND/OR BUSHING INSERT



FOUNDATION CLAMPS FOR SWITCHGEAR

PART #	MM#	DESCRIPTION	QTY.	PART #	MM#	DESCRIPTION	QTY.
(1)*	—	ELBOW, 200A OR 600A	A/R	(8)	30001499	SILICON BRONZE, 1/2" NUT	A/R
(2)*	—	BUSHING UGRD, INSERT, LOADBREAK	A/R	(9)	30001681	SILICON BRONZE, 1/2" DIA. WASHER	A/R
(3)*	30013112	FAULT INDICATOR, MECHANICAL TYPE	A/R	(10)	30006864	CONNECTOR, TERM BOLTED PAD #4 AWG	2
(4)	30001353	BOLT, HEX HEAD GALV GR2, 1/2" DIA, 1-3/4" LG	4 MIN.	(11)	30014480	BARE COND. COPPER #4	A/R
(5)	30001605	WASHER, LOCK HELICAL SPRING, 1/2" BOLT,	4 MIN.	(12)	30001591	WASHER, ROUND, STEEL, 1/2" BOLT	4 MIN.
(6)*	—	CAP UNDERGROUND, INSULATING	A/R	(13)	30006431	CONNECTOR, TERM BOLTED PAD, FOR C.N. WIRES (2/0 AL CABLE)	A/R
(7)*	30001184	SILICON BRONZE BOLT HEX HEAD 1/2" DIA., 1-1/2" LG	A/R	(14)	30006154	CONNECTOR, TAP, BOLTED	A/R

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
01	NOV 2011	4 GROUND RODS, GROUNDING DETAILS & MM# ADDED	WB / PC	* *

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
J. HICKS	D. PARIKH	NOV.15,2011

THREE-PHASE PAD-MOUNTED SWITCHGEAR INSTALLATION AND CONNECTIONS - TYPICAL

Dwg. No. DU-04-402 SH.2 OF 2 Rev. 01

SUB-SECTION 4C-5
EQUIPMENT PRIMARY TERMINATIONS & LABELING

Sub-Section 4C-5
Equipment Primary Terminations and Labeling

General

This section applies to the primary cable terminations installed within pad-mounted equipment.

Elbows and Bushings

While preparing the elbow terminations, adequate slack length of cables shall be kept inside the equipment foundation to prevent strain on the terminations or cables during elbow operations and its parking. See DU-04-301, DU-04-401 and DU-04-402.

Hydro One supplies and installs the elbows, bushing inserts and insulating caps.

For use of arresters within equipment, refer to Table 2 in Design Guide 3D and the drawing DU-03-502.

Identification and Marking

All primary cable ends shall be provided with temporary (but clear) identification, by the subdivision constructor, showing the source location number as per DU-03-501.

Additionally, within pad-mounted equipment, the number 1 is marked on the incoming (source side) cable, and numbers 2, 3, 4, etc. are marked on the outgoing/tap (load side) cables.

Hydro One supplies and installs the permanent identification on cable ends.

SUB-SECTION 4C-6
TRANSFORMER SECONDARY TERMINATIONS

Sub-Section 4C-6
Three-phase Transformer Secondary Terminations

Terminations in Pad Mounted Transformer

Secondary cables are supplied and installed by customers. For details of secondary cable terminations in Hydro One owned pad-mounted transformers see DU-04-601.

In This Section

This section contains the following drawings:

Description	Dwg. #	Rev.
Secondary Cable Terminations at Three-Phase Pad-Mounted Transformers	DU-04-601	R1

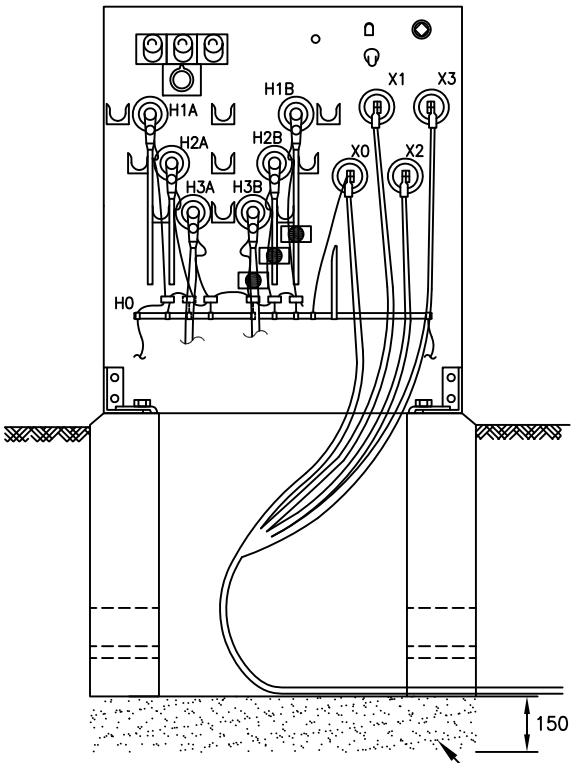
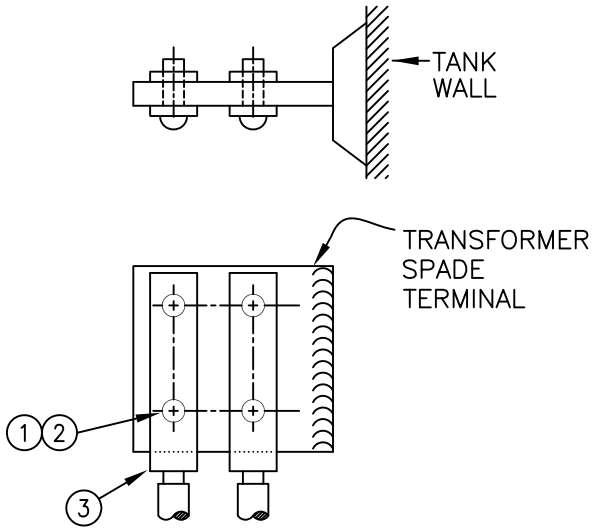


FIG. 1



CONNECTION OF 500MCM
SECONDARY CABLE (TYPICAL)

PART #	MM#	DESCRIPTION	QTY.
(1)	30001243	BOLT, HEX GALV, 3/8" DIA, 1-1/2" LG	4 MIN
(2)	30001628	WASHER, LOCK SPRING, 3/8" BOLT, GALV	4 MIN
(3)	AS NEEDED	CONN. TERM. COMPRESSION	4 MIN

NOTE:
1. SECONDARY CABLE CORES ARE IDENTIFIED BY USE OF COLOURED TAPE
   NEUTRAL: (X0)–WHITE
   PHASES: (X1)–RED
   (X2)–BLUE
   (X3)–BLACK
2. CABLE CONNECTORS, BOLTS & WASHERS ARE CUSTOMER SUPPLIED & INSTALLED.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 4C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
01	OCT 2011	MM# ADDED *	WB / PC	* *

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	*	NOV.15,2011

SECONDARY CABLE TERMINATIONS
AT THREE-PHASE PAD-MOUNTED TRANSFORMERS

Dwg. No. DU-04-601 Rev. 01

Section 6
Submarine Installations

Topic	Section #	Rev. Date
Design Guide- Submarine Cable Supply	6D	Nov 2011
Construction Guide- Submarine Cable Supply	6C	Nov 2011

SUB-SECTION 6C
CONSTRUCTION GUIDE
SUBMARINE INSTALLATIONS

Sub-Section 6C
Construction Guide
Submarine Installations

In This Section

This section details the construction-related requirements for the installation of submarine distribution systems.

This Section is divided into Sub-sections as follows:

Topic	Sub-Section	Rev. Date
Single-Phase Distribution up to 16 kV	6C (a)	Nov 2011
Three-Phase Distribution up to 27.6 kV	6C (b)	Nov 2011
44 kV Three-Phase Distribution	6C (c)	Mar. 2009

SUB-SECTION 6C (a)
SINGLE PHASE DISTRIBUTION
UP TO 16kV
SUBMARINE INSTALLATIONS

Sub-Section 6C (a)
Single-Phase Distribution up to 16 kV

In This Section

This section details the various construction related requirements for the installation of single-phase submarine distribution systems up to 16 kV.

This Section is divided into Sub-sections as follows:

Sub-Section 6C (a) – 1
General

Scope

This section applies to the construction of standard, single-phase submarine distribution systems operating at single-phase primary voltages up to 16 kV that:

- typically serve seasonal or residential customers on islands or along the shorelines of lakes
- are owned by Hydro One Networks Inc. (Hydro One)

The primary cable shall be in accordance with the latest edition of Hydro One Standard Specifications M-355.

The standard M-355 cable is single conductor, submarine cable with aluminum or copper core, individually jacketed copper-clad steel wire concentric neutral/armour and cross-linked polyethylene (TRXLPE) insulation. The cables of voltage classes 15 kV and 28 kV (phase-phase), are for operation on grounded neutral systems up to 8.0/13.8 kV and 16.0/27.6 kV respectively.

Purpose

The purpose of this section is to provide direction and support to constructors for the installation of submarine cable systems, and to inspectors for inspection of constructed facilities.

This construction guide is prepared to ensure that:

a) the submarine distribution systems, owned by Hydro One, are constructed on a consistent basis to provide for safe and reliable operation, and

b) only materials approved by Hydro One are used for the construction of such submarine distribution systems.

General Rules

Submarine distribution systems owned by Hydro One shall be constructed in accordance with the Hydro One approved design and layout drawings and shall comply with these standards. Any proposed deviation from these standards shall be submitted to, and approved by, Hydro One Technical Services prior to construction.

All customer-owned equipment shall comply with the Ontario Electrical Safety Code.

Safety

All construction shall be carried out with adequate safeguards to minimize the risk to the public, the workers and existing structures. All applicable construction safety requirements of Hydro One, OH&SA, Ministry of Natural Resources, local Municipalities and other regulators shall be followed.

As Built Drawings

Upon completion of construction, signed and red-lined "as-built" drawings shall be submitted to Hydro One.

Sub-Section 6C (a) - 2
Cable Installation – Primary and Secondary

General

This section details the standards for location of facilities, techniques for installing primary and secondary cable, means to minimize environmental impacts and construction details.

Primary Cable

The primary cable shall be in accordance with Hydro One Standard Specification M-355.

The standard M-355 cable is single conductor, submarine cable with aluminum or copper core, individually jacketed copper-clad steel wire concentric neutral/armour and cross-linked polyethylene (TRXLPE) insulation. The cables of voltage classes 15 kV and 28 kV (phase-phase), are for operation on grounded neutral systems up to 8.0/13.8 kV and 16.0/27.6 kV respectively.

The most common conductor size for M-355 cable is 1/0 solid aluminum, which is used for single-phase distribution.

Removal of Obstacles

It is common to encounter various obstacles in the proposed submarine cable corridor. These may include:

- other communication and/or submarine cables;
- pipelines, including water, sewer, and gas;
- effluent discharge pipes;
- submerged marine vessels, especially near docks and bridges;
- piers, docks, boat ramps, roadways, foundations, buildings, etc. (Note: These may be abandoned and not visible above the water surface;
- disposed material as a result of dredging or dumping of refuse;
- restricted areas (e.g. naval training or testing areas);
- marine life.

Where any such obstacles are encountered, it may be possible to remove or relocate the obstacle provided the permission of the owner/local authority is obtained. In many cases, where an alternate route is possible, it may be more economic to re-route the cable to avoid the obstacle.

Transportation

Submarine cable is normally delivered to the mainland over land routes. Whatever the delivery method; special accommodations to receive and store the cable may need to be made. Cables may be delivered to a staging area or directly to the job site.

Reel and Cable Handling and Storage

Normally, cable will be delivered in reel quantities. Provisions must be made for handling the reel when received and ensure that the reel-handling equipment is adequately rated for the size and weight.

Unspooling cable off the delivery reels may require a motorized reel-turning stand.

Minimum Bending Radius

Care should be taken that all handling equipment utilized and installation methods employed do not result in bending the cable in a smaller radius than recommended by the cable manufacturer – typically no less than twelve (12) times the cable diameter.

Such equipment may include:

- reels and coils,
- sheaves, rollers, and fantail,
- tensioning equipment,
- turntables.

The bending radius for most common sizes of M-355 cable in submarine distribution are given in Table 1:

Table 1

Bending Radius of M-355 Cable
mm [Inch]

Conductor Size AWG	**M-355** Cable with 19x #12BWG individually jacketed steel wire concentric neutral/armour	New **M-355** Cable with 21x #10AWG individually jacketed copper- clad steel wire concentric neutral/armour
1/0 (Solid AL)	435 [17]	417 [16.5]

Note: For the bending radius of other sizes refer to the manufacturer data on outer diameter of the cable.

Cable Laying Floats and Barges

The following points are to be considered when evaluating the adequacy and operation of a cable-laying vessel:

a) adequacy

- anchoring provisions;
- cable-tensioning devices (linear engine or capstan with adequate braking capability);
- draft adequate for load;
- dynamic positioning with GPS interface;
- lay control equipment (tension dynamometers, lay angle devices, etc.) integrated with the vessel positioning system;
- laying sheave or sheaves with adequate diameters;
- propulsion system (on-board or tugs);
- stability of the vessel in high wind/wave action;
- weight limitations;
- communications with adequate communication frequencies;
- ability to follow a route within a given tolerance;
- required bottom position accuracy;
- survey control system.

b) operation

If using a larger vessel, one worker should be assigned as operator or captain of the barge who is qualified in the operation of the vessel and familiar with the work being performed. The vessel must be capable of holding the combined load of cable reel, trailer, tools and equipment and personnel on board.

The center of gravity must be kept as low as practicable for increased stability. If possible, a vessel with a reel well is preferable to achieve this. Loads must be properly balanced and secure.

Vessels, whether owned or rented, must be checked for proper load capacity ratings, proper licensing, registration and identification/markings.

Cable Embedment

In most Hydro One situations, there will not be a need to bury cable along its length in water. In most cases, water travel will be limited to pleasure craft, which do not pose a threat to cable security or damage. The protection of cable at the shoreline area will normally suffice. To prevent damage from mechanical threats, however, a cable may be buried along its route. Because there is a high cost associated with embedment along its route, selection of possible alternative routes should be the first priority to avoid embedment.

Only in cases where marine traffic includes shipping or anchoring in the vicinity of the cable should cable be embedded in the river or lakebed.

Burial Depth

Should there be no other option but to bury the cable along its route, the depth of burial depends on what is being protected against. For example, a cable may be buried deeper than the deepest expected dredging activity, deeper than an anchor will penetrate into the bottom when dropped, deep enough to avoid the flukes of a dragging anchor, or deep enough to avoid abrasion caused by high currents and ice buildup. In cases where the burial of cable is thought to be required, Technical Services shall be consulted for guidance.

Embedment Techniques

A number of embedment techniques may be used. These include specially built machines that insert the cable into the bottom, either as the cable is being laid or after the cable is laid ("post-embedment"). Some machines can cut through rock. Most are pulled along the bottom with lines attached to a surface vessel.

Water jet plows, vibratory plows, or high-force plow machines can simultaneously dig a trench and embed the cable.

Trench Excavation

Trench excavation will normally be limited to the shoreline area from the dip pole to the water, and from the water to the padmount transformer or riser pole.

Trenching techniques and equipment include:

i) hand jetting;

ii) backhoe;

iii) chain saw trencher;

iv) trackhoe mounted on a barge;

v) explosive charges.

See DWGs DU-03-205 and DU-03-207 for trench excavation on land.

Mechanical Protection for Primary Cable

Submarine cable shall be mechanically protected in the area of the shoreline. (The shoreline is normally considered to be 1 m above the high water level and 1 m below the low water level.) Where practical, submarine cable should follow the shortest route from the shoreline to the transformer or shoreline to the pole. Mechanical protection is also required when the cable is laid on rock surfaces, and at the entry to padmounted gear. Alternatives for mechanical protection are:

i) Polyethylene Pipe

Polyethylene pipe is the preferred method of protection at the shoreline. Where trenching is employed to the shoreline, the cable shall be placed in buried polyethylene pipe from the on-shore trench to a minimum of 6m beyond the low water level. Two inch (2 in.) diameter ASTM Schedule 40 (or equivalent) High Density Polyethylene (HDPE with ultraviolet stabilizers) duct is suitable for M-355, 1/0 aluminum conductor cable.

ii) Poured Concrete

On rocky surfaces, cables shall be protected with poured concrete. Cable may be placed in shallow stable cracks or crevices in the rock. Where necessary, enlarge the crack or crevice to accommodate the cable.

Where cracks or crevices in the rock are utilized, cable should be covered by a minimum thickness of 75 mm of concrete with a minimum strength of 20 MPa after 28 days c/w air entrainment. Note: If concrete is to be buried, air is not needed. Maximum aggregate size shall not exceed 20 mm. Before pouring concrete, wash rock clean of dirt and debris that may interfere with the bonding of the concrete with the rock surface. It is desirable to leave the surface in a roughened condition prior to curing so that over time its surface will accumulate debris and render it less obtrusive. On rock, where cable cannot be inset in this manner, cable shall be run through poly-duct laying on the rock, and the duct shall be covered by concrete. The minimum thickness of the concrete shall be 75 mm.

iii) Articulated Pipe Protection

In exceptional cases where other shoreline protection methods are unsuitable or ineffective, e.g. hard rock surfaces with severe ice conditions, cables shall be protected with an adequate number of articulated pipe sections as shown in Drawing DU-06-405. The sections shall extend a minimum of one meter above the high water mark to a water depth of one meter below the low water level. The uppermost pipe section must be secured through the eye of the section to a rock anchor using guy steel and preform grip to maintain its position. The remaining pipes may move around the cable with shoreline abrasion influences.

The weight of the articulated pipe will help keep movement of the submarine cable to a minimum and the cable firmly on the bottom. The cable will be protected from incidental contact and ice damage.

Removal of Damaged Cable

If the core conductor has been exposed to water, sufficient cable (at least 1 m) must be removed to ensure that there is no water present between core and insulation. Remove any portion of the cable that may have been damaged by pulling grips (at least 1 m beyond the pulling grip attachment point). Train the cable into its approximate final position and cut to length.

Cable Splicing

Shore-end splices, on land, where required, utilize splicing techniques and materials for standard underground cables. Manufacturer's installation instructions for the splice selected must be followed.

Where splicing cannot be avoided and where approved by the Hydro One Project Designer, approved field splices may be used for submarine sections. An approved cold shrink splicing kit is available for commonly used M355-specified 28kV cables, including a cold shrink silicone rubber body, cold shrink jacket, conductor connector, armour wire connectors and a protective exterior cast. Manufacturer's installation instructions for the splice must be followed. Special splice designs are not recommended.

In addition to the manufacturer's installation instructions, it is important to ensure the cable ends are undamaged prior to installation of the splice. If the core conductor has been exposed to water, sufficient cable must be removed to ensure that there is no water present between core and insulation. Remove any portion of the cable that may have been damaged by pulling grips, etc. Ensure armor wire is not corroded at the end and that the semi-conductive polyethylene covering on the armor wires is not damaged. Typically up to 5 m (16.4 ft) length of cable may be required to be cut, from the end which has been exposed to water.

In locations where considerable cable movement or external forces are expected, approved splice boxes may be used for protection and tension reduction.

Cable Labeling

All primary cable ends shall be provided with temporary (but clear) identification, by the submarine cable installation constructor, showing the source location. Labeling shall be as per DU-03-501. Additionally, within padmounted equipment, the number 1 is marked on the incoming (source side) cable, and numbers 2, 3, 4, etc. are marked on the outgoing/tap (load side) cables.

Hydro One supplies and installs the permanent identification on cable ends.

Signs and Markers for Submarine Cable Systems

Signs and Markers for submarine cable crossings shall be in accordance with Drawing DU–06-401 and DU–06-402.

On submarine cable crossing of watercourses used primarily by pleasure craft, a buried submarine cable post type marker shall be installed at each end of the cable crossing. The marker shall be clearly visible from the waterway and not obscured by vegetation, trees, or manmade obstructions, and no more than 3m above the high water level. Refer to Drawing DU-06-401.

On submarine cable crossing of shipping channels used by larger commercial type vessels, the cable crossing shall be marked as above, plus include a highly visible "No Anchor" sign installed in a clearly visible location one meter above the high water line. The sign shall be a minimum size to be clearly legible from the centre of the shipping channel and shall be mounted either on the submarine cable termination poles or other suitable permanent support. Refer to Drawing DU-06-402.

Secondary Cable Responsibility

A standard secondary cable is supplied by Hydro One and shall be 3/0 Al. (Note: Supply and termination of standard secondary cable is a Hydro One responsibility.)

If the customer chooses to provide and install his own secondary cable, then the customer shall obtain approval for the cable and its installation from ESA. This will be considered as a non-standard installation. Non-standard installations are expected to occur many times.

The secondary cable supplies the customer meter base from the padmount transformer/kiosk, or pole top transformer.

Should the customer require a non-standard secondary cable, the customer must supply it as well as any required accessories. Accessories shall include but not be limited to terminal connectors, insulated bushings, ground bushings, weatherhead, etc. If Teck 90 cable with its termination accessories is supplied by the customer, its installation shall be in accordance with Drawing DU-06-301B.

Sub-Section 6C (a) – 3
Overhead to Underground Transition

General

This section details the standards for installation of cable termination and related accessories on poles located on the mainland and islands where the overhead circuit terminates on (the "dip pole"), transitions to a submarine cable, and where the submarine cable transitions on (the "riser pole") to an overhead conductor. This instruction is applicable for system voltages up to 16 kV.

Stand-off Brackets

Stand-off brackets facilitate access to pole-mounted equipment by climbing. These can be used where vehicular access is not possible and there is more than one cable on the pole. Riser poles and/or dip poles may utilize stand-off bracket to support any combination of primary/secondary/communication cables. The bracket has space on both sides which would allow distinct separation of primary cables from secondary and communication cables. Refer to Drawing DU-06-403. If the riser pole is in close proximity to roadways, Refer to Note 10 on Sheet 1/2 of Drawing DU-06-202.

Primary Cable Installation

Pole-mounted primary submarine cables shall be installed with cold shrink terminations. Where vehicular access to the pole mount equipment is possible, the cable shall be installed on the pole protected by a metallic guard from at least 600 mm below grade to the full length of cable run on the pole as shown in Drawing DU-08-302. Where vehicle for aerial access is not available or vehicular access is not possible, the cable shall be installed in PVC riser supported by stand-off brackets. The cable and its termination shall be adequately supported on the bracket as shown on the drawings. The cable bending radius shall not be less than 12 times the cable diameter. To allow for ground settlement, some slack shall be kept on the cable at the pole base.

Grounding Conductors

Grounding conductors on poles shall be protected as a minimum with a wood guard for the length of the conductor up to the connection point to the neutral. If the riser pole is in close proximity to roadways, the wood guard should be further protected by a one piece metal guard buried to a depth of minimum 30 cm below grade extending up to 2.2 meters above ground as shown in Drawing DU-06-404, or to be installed on the side of the pole that is not adjacent to the road.

Armour Shield	The armour of primary submarine cables on riser and dip poles shall be connected to the system neutral conductor and shall be grounded at both ends of the cable section. Refer to Drawings DU-06-101 Sheet 1/2 for concentric neutral-cum-armour grounding of M-355 specification cable.
Orientation of Attachments On Stand-off Bracket	The primary cable shall be oriented on the face of the stand-off bracket. Communication and secondary cables (if required) shall be positioned on the back surface of the stand-off bracket, between bracket and pole, and placed in such a way as not to impede the positioning of submarine cable. Refer to Drawing DU-06-403. **Note:** None of the attachments shall interfere with the use of lineman's climbers.
Transformer, Cutout, Surge Arrester	A maximum of one (1) transformer and associated fused cutout and metal oxide surge arrester shall be mounted on the riser pole using standard mounting hardware.

Sub-Section 6C (a) – 4
Grounding

General

This section details the standards for installation of grounding systems that are adequate to protect against excessive ground potential rise during normal operating conditions, under fault conditions, and lightning surges. The standard M-355 cable is a single conductor, submarine cable with aluminum or copper core, individually jacketed copper-clad steel wire concentric neutral/armour and cross-linked polyethylene (TRXLPE) insulation. The concentric neutral-cum-armour shall be grounded at both ends.

Grounding Conductor

Ground conductors used shall be bare copper, #4 AWG, 7 strands, or bare copper 1/0, 7 strands. The riser pole ground conductor shall be bare copper, #4 AWG, 7 strands for 4-wire distribution circuits. Equipment grounding conductors, if required, shall be bare copper, #4 AWG, 7 strands. The connections from armour wires and concentric neutral wires to the pole ground conductor, if required, shall be bare copper 1/0, 7 strands, as indicated in the drawings in Section 6C (a) -8.

Grounding Connections

All connections between grounding conductors and between grounding conductors to grounding plates/ground rods shall use approved connectors. Below ground connections shall use only the connectors that are approved for direct burial/concrete encasement application.

Grounding Rods, Grounding Plates

Grounding rods shall be the preferred alternative. Where use of ground rods is not feasible due to rocky conditions, ground plates are an acceptable alternative and these must be installed on undisturbed soil and used in conjunction with GEM (Ground Enhancement Material). A minimum of four (4) rods/plates per padmount transformer and switching kiosk, and one (1) rod/plate per pole shall be installed. Refer to Drawings DU-06-303, DU-06-305 and DU-06-404 for pole and/or equipment grounding details.

Ground Resistance

A minimum ground resistance of twenty-five (25) ohms shall be achieved at the pole location.

Ground resistance may be measured by the 3-point method using a ground resistance tester and 2 remote electrodes, before the ground rod is connected. Alternatively a clamp-on ground resistance tester can be used after the connection to the ground wire and neutral has been made.

As many as two (2) additional ground rods/plates should be installed to reduce the ground resistance if the minimum number of ground rods/plates cannot achieve a 25 ohm ground resistance.

Sub-Section 6C (a) – 5
Padmount Equipment

Padmount Transformer

The typical padmount transformer used in submarine applications is referred to commonly as the “ranch runner” or “micro-pad” transformer. The transformer is normally rated at 10 kVA and 25 kVA. The transformer shall be securely mounted to the transformer foundation. Refer to Drawing DU-06-302

Transformer Foundation/ Kiosk/Vault

The foundation shall be mounted on a level surface (where possible) of compacted gravel approximately 220 mm below grade. The top of the transformer foundation shall be approximately 100mm above the finished grade. When it is not possible to find an adequately-sized level surface to mount the foundation, a concrete pad shall be installed on which to install the foundation. The transformer foundation shall be as per drawings DU-06-302, DU-06-304, 304A, and 304B. Adequate slack shall be left in the cable for cable and concentric/armour connections and to facilitate easy removal and parking of elbows using live line tools.

Transformer, Kiosk Fault Indicators

The fault indicators shall be located on:

- the submarine cable/s connected to the H1B bushing of every padmounted transformer.
- each load side/outgoing submarine cable of every kiosk/switchgear.
- for underground primary equipment located on islands, fault indicator shall be located as shown in drawings DU-06-301A & B.

Use of Helicopters

Due to difficult site conditions, helicopters may be required for transporting heavy equipment to site. For detailed work instructions on use of helicopters for equipment transport, refer to HO 2523 R3.

Sub-Section 6C (a) – 6
Documentation

As-Built Documentation

Submarine cable systems commonly operate for many years without requiring any repairs. When a component requires repair or replacement, it is important to have an accurate document that summarizes construction details.

The document should include:

i) plan and profile of where the cable was laid, both in the water and on land, including survey;
ii) control points and landmarks;
iii) location of obstructions;
iv) locations of splices;
v) complete Submarine Distribution System Mapping and drawings including GPS co-ordinates of splices;
vi) photographs.

Sub-Section 6C (a) – 7
Cleanup and Restoration

Cleanup and Restoration

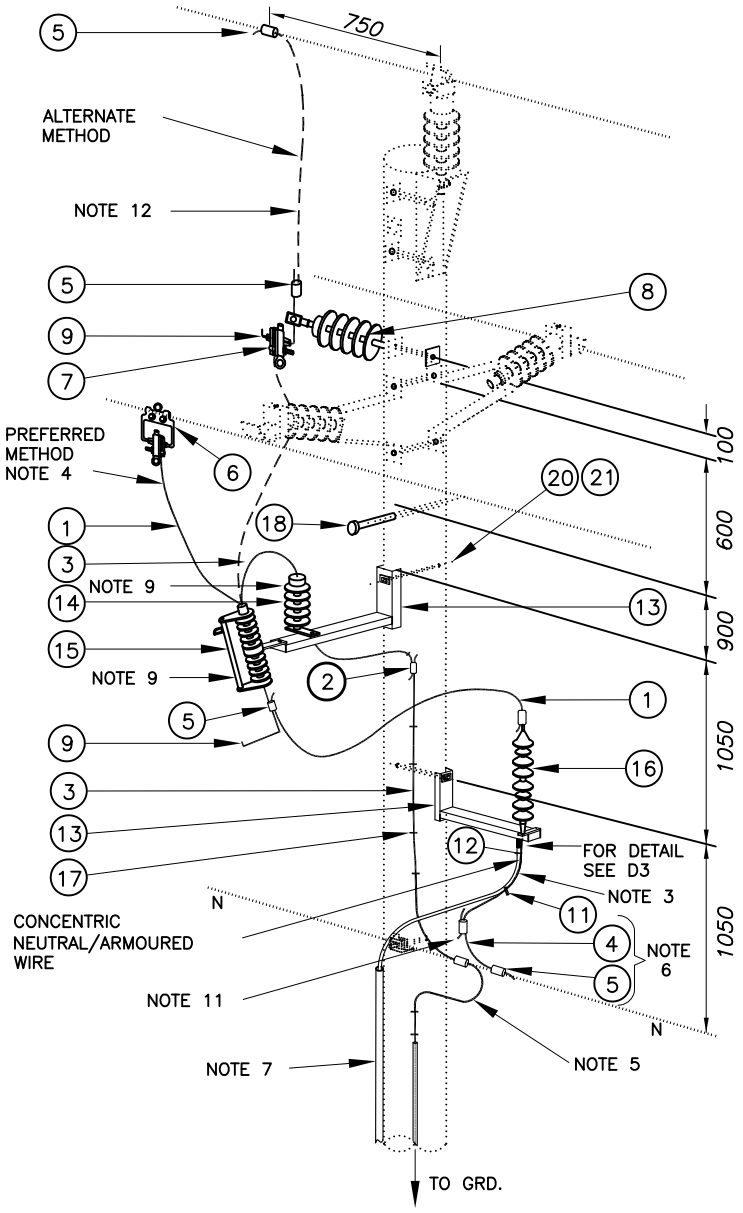
Aquatic vegetation removed during the trenching operation should be contained and adequately disposed of on land. Vegetation allowed to drift downstream may adversely affect downstream users as the result of flow obstruction or choking of water intakes. Decaying vegetation may also cause odor and aesthetic problems.

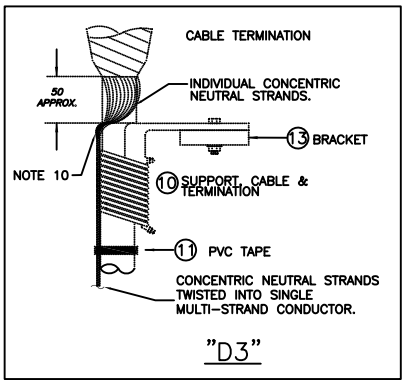
Sub-Section 6C (a) – 8
References and Drawings

In This Section This section contains the following drawings:

Description	Dwg. #	Rev.
Fused Primary Submarine Cable Termination – 1-phase, 2.4 to 16 kV	DU-06-101	R2
Fused Primary Submarine Cable Termination – 1-phase, 2.4 – 16 kV – Non-Preferred Installation	DU-06-101A	R1
Un-fused Primary Submarine Cable Termination – 1-phase, 2.4 – 16 kV	DU-06-102	R2
Transformer and Submarine Cables on the Same Pole – 1-phase, 2.4 – 16 kV – Dead End	DU-06-103	R2
Transformer and Submarine Cables on the Same Pole – 1-phase, 2.4 – 16 kV – Tangent	DU-06-103A	R2
Micropad Transformer Installation, Up to 25kV.A, 1-phase, 2.4 – 14.4 kV	DU-06-301	R2
Micropad Transformer Installation, Up to 25kV.A. 1-phase, 2.4 – 14.4 kV – 2 Load Side Primary Submarine Cables	DU-06-301A	R2
Micropad Transformer Installation (With Teck Cable), up to 25 kVA, 1 Phase – 2.4 to 14.4 kV	DU-06-301B	R2
Transformer and/or Kiosk Base Installation in Earth or on Rock – Aluminum Base	DU-06-302	R2
Micropad Equipment Grounding Details – Typical and Alternate Arrangements	DU-06-303	R2
Aluminum Base – Micropad Transformer	DU-06-304	R1
Aluminum Base – 1-phase, Low Profile Conventional Transformer	DU-06-304A	R1
Aluminum Base – Switching Kiosk	DU-06-304B	R1
Single-Phase Padmounted Kiosk Installation – Aluminum Base	DU-06-305	R2
Submarine Cable – Warning Sign Installation	DU-06-401	R1
Warning Sign – Stay Clear – High Voltage Cable	DU-06-401A	R1
Submarine Cable Crossing – Standard “No Anchor” Sign	DU-06-402	R1
Submarine Cable Stand-off Bracket – Wood Poles	DU-06-403	R1

Grounding Details at Primary Riser/Dip Pole	DU-06-404	R2
Shoreline Protection of Cables with Articulated Pipe	DU-06-405	R1

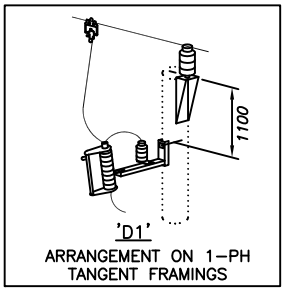




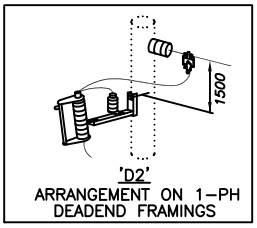
"D3"

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
250	10"
600	2'-0"
750	2'-5"
900	3'-0"
1050	3'-6"

NOTES:
1. FOR PARTS LIST AND OTHER DETAILS SEE DRAWING DU-06-101 SHEET 2.
2. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
3. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
4. USE THE PHASE REQUIRED FOR LOAD BALANCE AND EASE OF CONNECTION.
5. SLACK LOOP OF GROUND WIRE.
6. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
7. THE PREFERRED INSTALLATION FOR CABLES ON A POLE IS COVERED BY METAL GUARDS AS PER DU-08-302. STANDOFF BRACKETS MAY BE USED WHERE AERIAL DEVICE ACCESS IS UNAVAILABLE. REFER TO DU-06-403.
8. FOR PRIMARY CABLES WITH SEPARATE CONCENTRIC NEUTRAL AND STEEL ARMOURED WIRES (M-695 SPEC CABLES), CONNECT BOTH ENDS OF THE ARMOUR SHEATH TO GROUND. SEE DU-06-101 SHEET 2.
9. REFER TO OVERHEAD DISTRIBUTION STANDARDS - SECTION 8 FOR CUTOUT AND ARRESTER SELECTION.
10. FOLD BACK, BUNDLE TOGETHER, ATTACH TO CABLE BY TAPE, AND THEN CONNECT TO NEUTRAL.
11. FOR EXPOSED ENDS OF PE COVERED STEEL ARMOURED CABLE, ALWAYS SUSPEND CABLE POINTING DOWNWARDS TO STOP MOISTURE INGRESS. THE PE COVERING WILL BE ONLY SKINNED BACK FAR ENOUGH FOR AN AMPACT.
12. JUMPER AMPACITY SHOULD AT LEAST EQUAL CABLE AMPACITY.



'D1'
ARRANGEMENT ON 1-PH TANGENT FRAMINGS



'D2'
ARRANGEMENT ON 1-PH DEADEND FRAMINGS

REFERENCES:

SECTION 1	DEFINITIONS
SECTION 6C	CONSTRUCTION GUIDE
SECTION 8	O/H DIST. STD.
SECTION 16	MATERIALS LIST

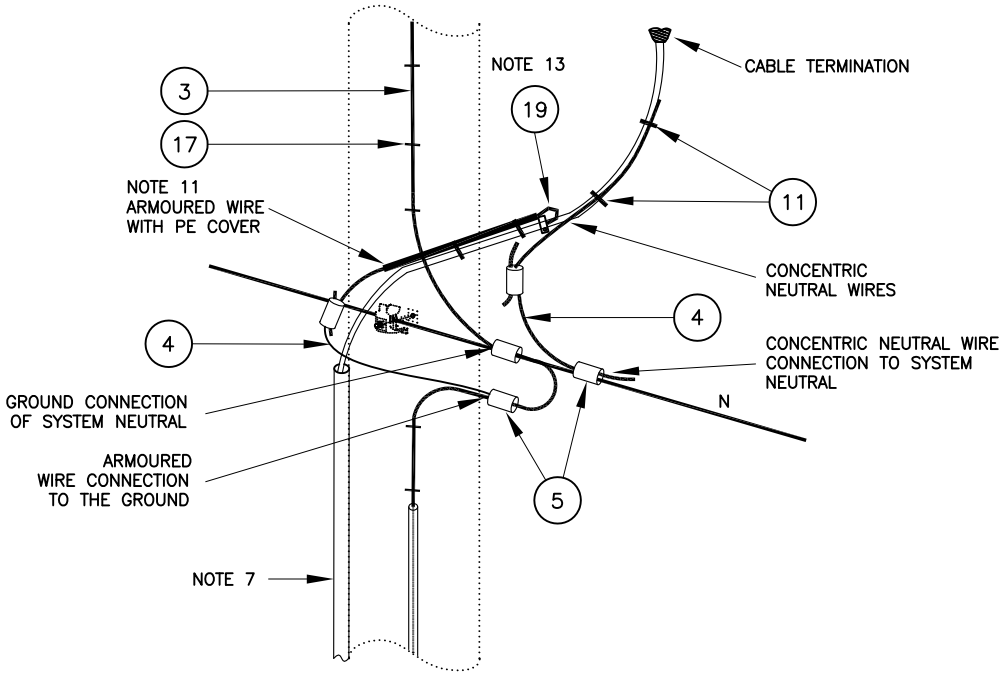
Rev. No.	Issue Date	Revision	Dwn	Approved By
*	*	*	*	
02	NOV 2011	REDRAWN WITH EDITORIAL CHANGES AND REDRAWN DETAIL 3	PC	
			Chk	Date

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. Vidad	*	NOV.16,2011

FUSED PRIMARY SUBMARINE CABLE TERMINATION
- 1 PHASE, 2.4 TO 16 kV

Dwg. No. DU-06-101 SH. 1 OF 2 Rev. 02



CONCENTRIC NEUTRAL AND ARMOURED CONNECTION FOR PRIMARY CABLE – M695 SPEC

PART #	MM #	DESCRIPTION	QTY.
①	30005821 30005823 30005825	BARE COND, COPPER, 1/0 AWG, MHD SAME--2/0 SAME--4/0	AS REQD
②	30006509	CONNECTOR, TAP COMP, 6AWG – 4AWG	1
③	30014480	BARE COND, COPPER, 4AWG, 7 STRAND, SD	AS REQD
④	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
⑤	AS REQD	CONNECTOR, TAP WEDGE	AS REQD
⑥	AS REQD	CONNECTOR, STIRRUP, BOLTED	1
⑦	30007392	CONNECTOR, LIVE LINE	1
⑧	30008425	INSULATOR, STANDOFF 28 kV	1 MAX
⑨	30000770	CLAMP REST, INSULATOR TYPE	2 MAX
⑩	30008041	SUPPORT, CABLE & TERMINATION	1
⑪	30008331	TAPE, ELECTRICAL, PVC, BLACK	AS REQD
⑫	30010073 30010074 30010075	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	AS REQD
⑬	30000825	BRACKET, CUTOUT & ARRESTER	2
⑭	AS REQD	SURGE ARRESTER, RISER POLE	1
⑮	AS REQD	CUTOUT, FUSED	1
⑯	30007446	TERMINATION, COLD SHRINK, 28 kV, 1/0	1
⑰	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	AS REQD
⑱	30000777	CLAMP REST, POLE TYPE	1
⑲	30003502	CLAMP, GEAR TYPE	1
⑳	AS REQD	BOLT, 3/4" DIA.	AS REQD
㉑	30001595	WASHER, SQUARE, 3/4" x 2" x 2"	AS REQD

NOTES (CONTINUED):

13. FOR CABLES WITH BOTH CONCENTRIC NEUTRAL AND ARMOR WIRE, THE ARMOR WIRE SHALL BE REMOVED APPROXIMATELY MID-WAY BETWEEN THE BASE OF THE TERMINATION AND THE TOP OF THE CABLE GUARD. A WORM GEAR TYPE HOSE CLAMP SHALL BE INSTALLED AND TIGHTENED AROUND THE ARMOUR AT THIS POINT. THE ARMOUR STRANDS ABOVE THE CLAMP SHALL BE UNRAVELED AND BENT BACK OVER THE CLAMP AND COLLECTED ON ONE SIDE OF THE CABLE. THE COLLECTED STRANDS SHALL BE JOINED TO A LENGTH OF 1/0 BARE COPPER CONDUCTOR WITH AN APPROPRIATE CONNECTOR.

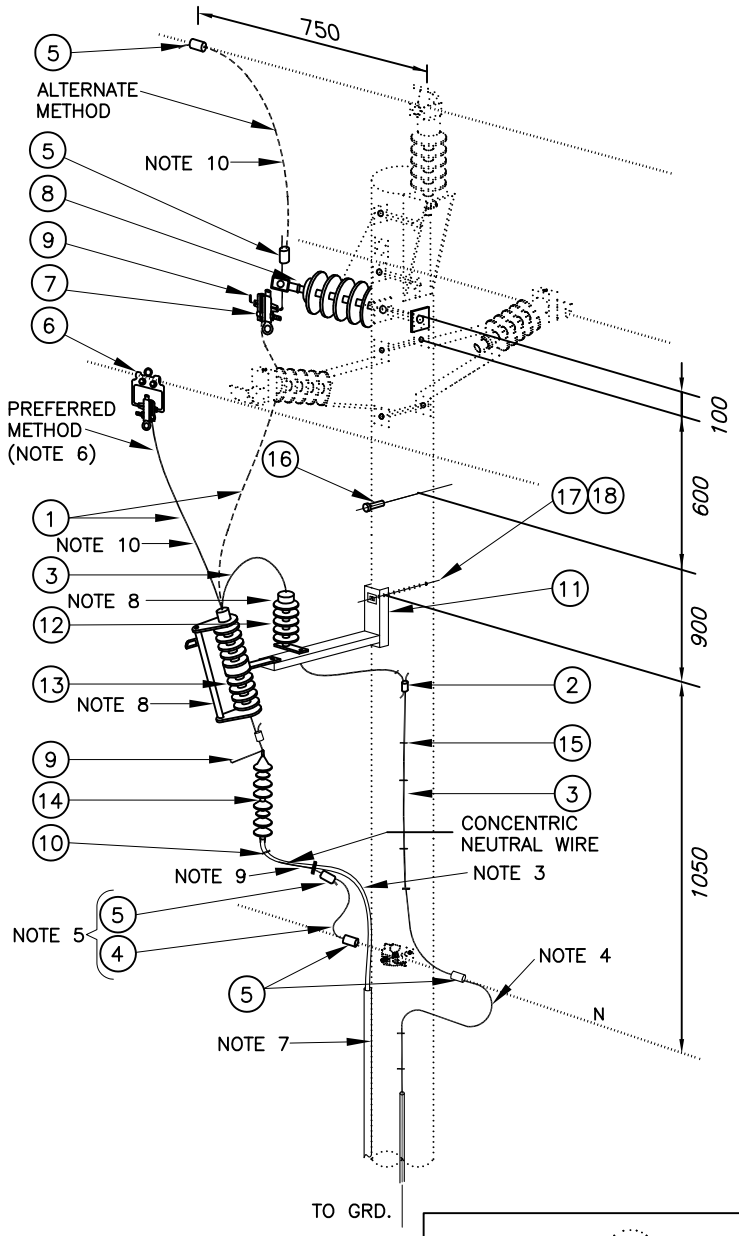
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
*	* *	* *	*	
02	NOV 2011	REDRAWN WITH EDITORIAL CHANGES	PC *	

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

FUSED PRIMARY SUBMARINE CABLE TERMINATION
- 1 PHASE, 2.4 TO 16 kV

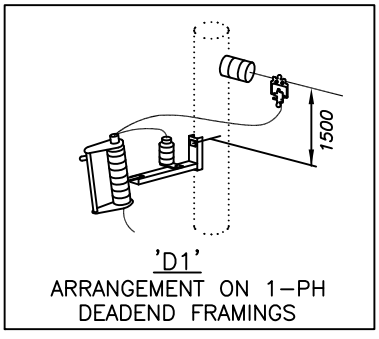
Dwg. No. DU-06-101 SH. 2 OF 2 Rev. 02



PART #	MM #	DESCRIPTION	QTY.
①	30005821 30005823 30005825	BARE COND, COPPER, 1/0 AWG, MHD SAME--2/0 SAME--4/0	AS REQD
②	30006509	CONNECTOR, TAP COMP, 6AWG – 4AWG	1
③	30014480	BARE COND, COPPER, 4AWG, 7 STRAND, SD	AS REQD
④	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
⑤	AS REQD	CONNECTOR, TAP WEDGE	AS REQD
⑥	AS REQD	CONNECTOR, STIRRUP, BOLTED	1
⑦	30007392	CONNECTOR, LIVE LINE	1
⑧	30008425	INSULATOR, STANDOFF 28 kV	1 MAX
⑨	30000770	CLAMP REST, INSULATOR TYPE	2 MAX
⑩	30010073 30010074 30010075	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	AS REQD
⑪	30000825	BRACKET, CUTOUT & ARRESTER	1
⑫	AS REQD	SURGE ARRESTER, RISER POLE	1
⑬	AS REQD	CUTOUT, FUSED	1
⑭	30007446	TERMINATION, COLD SHRINK, 28 kV, 1/0	1
⑮	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	AS REQD
⑯	30000777	CLAMP REST, POLE TYPE	1
⑰	AS REQD	BOLT, 3/4" DIA.	AS REQD
⑱	30001595	WASHER, SQUARE, 3/4" x 2" x 2"	AS REQD

NOTES

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. THIS IS A NON–PREFERRED INSTALLATION, TO BE USED ONLY TO AVOID A POLE CHANGE & WITH 1/0 CABLE. FOR PREFERRED INSTALLATION SEE DU–06–101.
3. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
4. SLACK LOOP OF GROUND WIRE.
5. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
6. USE THE PHASE REQUIRED FOR LOAD BALANCE AND EASE OF CONNECTION.
7. THE PREFERRED INSTALLATION FOR CABLES ON A POLE IS COVERED BY METAL GUARDS AS PER DU–08–302. STANDOFF BRACKETS MAY BE USED WHERE AERIAL DEVICE ACCESS IS UNAVAILABLE. REFER TO DU–06–403.
8. REFER TO OVERHEAD DISTRIBUTION STANDARDS – SECTION 8 FOR CUTOUT AND ARRESTER SELECTION
9. FOR EXPOSED ENDS OF PE COVERED STEEL ARMOURED CABLE, ALWAYS SUSPEND CABLE POINTING DOWNWARDS TO STOP MOISTURE INGRESS.
10. JUMPER AMPACITY SHOULD AT LEAST EQUAL CABLE AMPACITY.



'D1'
ARRANGEMENT ON 1–PH DEADEND FRAMINGS

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
600	2'–0"
750	2'–6"
900	3'–0"
1050	3'–6"
1500	5'–0"

REFERENCES:

SECTION 1	DEFINITIONS
SECTION 6C	CONSTRUCTION GUIDE
SECTION 8	O/H – U/G TRANSITIONS
SECTION 8	OVERHEAD DISTRIBUTION STANDARDS
SECTION 16	MATERIALS LIST

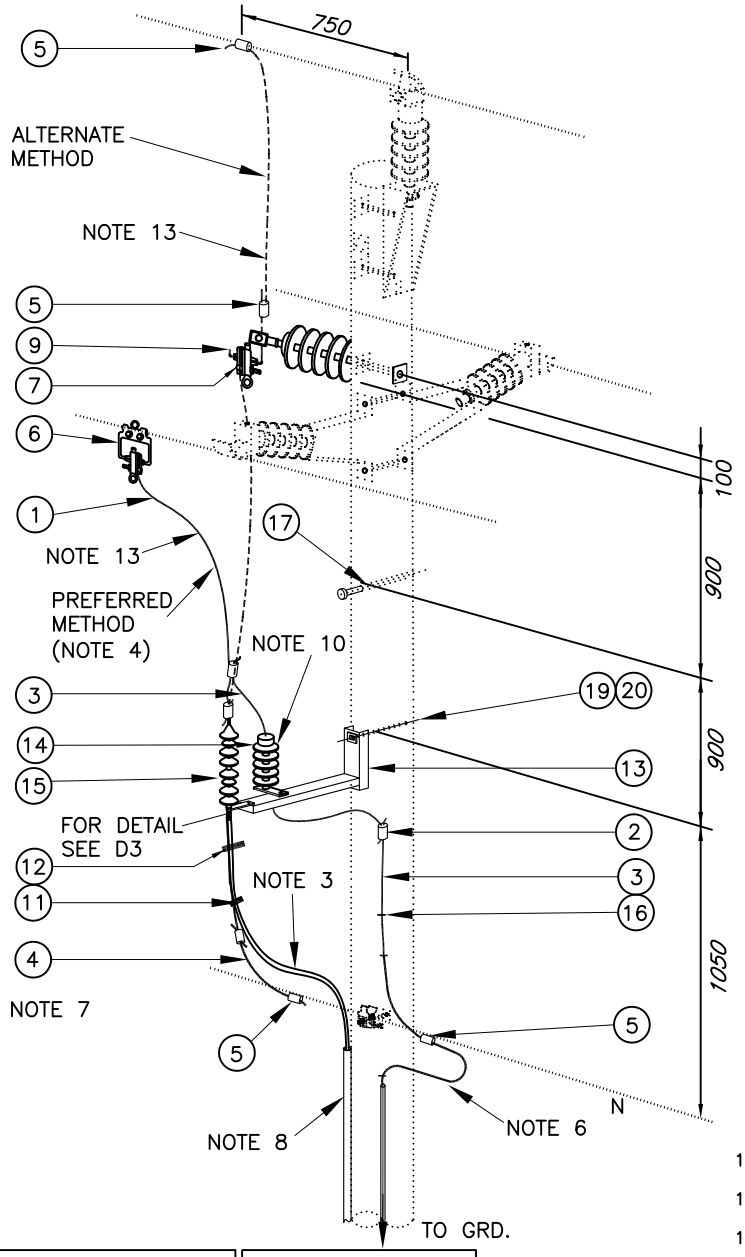
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
*	* *	* *	* *	
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	* *	

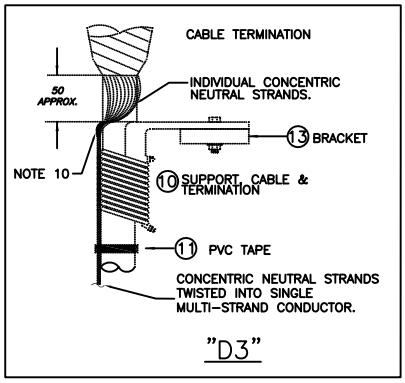
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	*

FUSED PRIMARY SUBMARINE CABLE TERMINATION - 1 PHASE, 2.4 - 16 kV NON - PREFERRED INSTALLATION

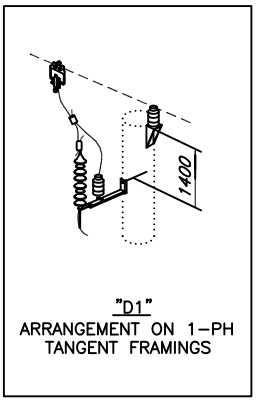
Dwg. No. DU-06-101A Rev. 01



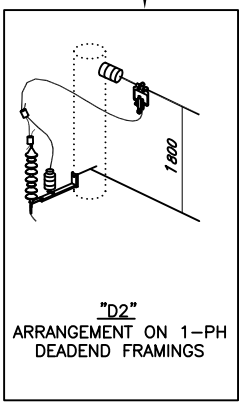


"D3"

NOTES
1. FOR PARTS LIST AND OTHER DETAILS SEE DRAWING DU-06-102 SHEET 2.
2. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
3. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
4. USE THE PHASE REQUIRED FOR LOAD BALANCE AND EASE OF CONNECTION.
5. OTHER END OF THE PRIMARY SUBMARINE CABLE MUST HAVE FUSED PROTECTION.
6. SLACK LOOP OF GROUND WIRE.
7. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
8. THE PREFERRED INSTALLATION FOR CABLES ON A POLE IS COVERED BY METAL GUARDS AS PER DU-08-302. STANDOFF BRACKETS MAY BE USED WHERE AERIAL DEVICE ACCESS IS UNAVAILABLE. REFER TO DU-06-403.
9. FOR PRIMARY CABLES WITH SEPARATE CONCENTRIC NEUTRAL AND STEEL ARMOUR WIRES (M-695 SPEC CABLES), CONNECT BOTH ENDS OF THE ARMOUR SHEATH TO GROUND. REFER TO DRAWING DU-06-201 SHEET 2.
10. REFER TO OVERHEAD DISTRIBUTION STANDARDS – SECTION 8 FOR ARRESTER SELECTION.
11. FOLD BACK, BUNDLE TOGETHER, ATTACH TO CABLE BY TAPE, AND THEN CONNECT TO NEUTRAL
12. FOR EXPOSED ENDS OF PE COVERED STEEL ARMOURED CABLE, ALWAYS SUSPEND CABLE POINTING DOWNWARDS TO STOP MOISTURE INGRESS. THE PE COVERING WILL BE ONLY SKINNED BACK FAR ENOUGH FOR AN AMPACT.
13. JUMPER AMPACITY SHOULD AT LEAST EQUAL CABLE AMPACITY.



"D1"
ARRANGEMENT ON 1-PH TANGENT FRAMINGS



"D2"
ARRANGEMENT ON 1-PH DEADEND FRAMINGS

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
250	10"
750	2'-6"
900	3'-0"
1050	3'-6"
1800	6'-0"

REFERENCES:

SECTION 1	DEFINITIONS
SECTION 6C	CONSTRUCTION GUIDE
SECTION 8	O/H – U/G TRANSITIONS
SECTION 8	O/H DIST. STD.
SECTION 16	MATERIALS LIST

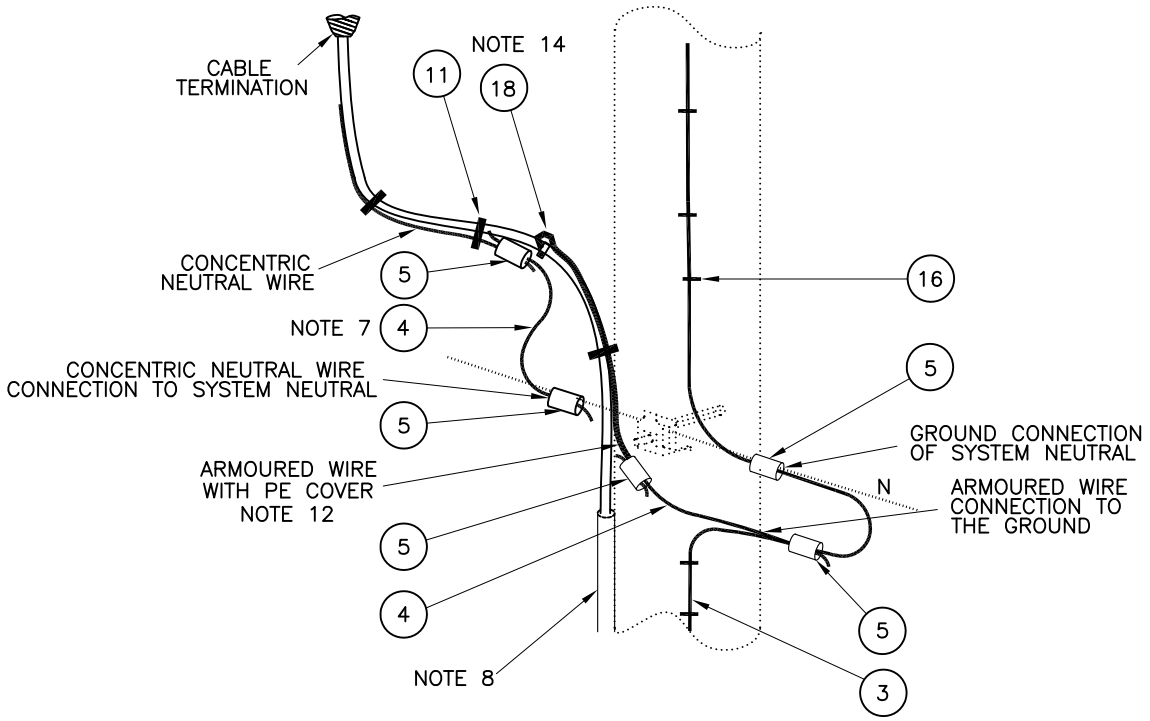
Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	* *	* *	*			
02	NOV 2011	REDRAWN WITH EDITORIAL CHANGES AND REDRAWN DETAIL 3	PC	*		

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

UNFUSED PRIMARY SUBMARINE CABLE TERMINATION
- 1 PHASE, 2.4 TO 16 kV

Dwg. No. DU-06-102 SH. 1 OF 2 Rev. 02



CONCENTRIC NEUTRAL AND ARMOURED CONNECTION FOR PRIMARY CABLE – M–695 SPEC

PART #	MM #	DESCRIPTION	QTY.
①	30005821 30005823 30005825	BARE COND, COPPER, 1/0 AWG, MHD SAME––2/0 SAME––4/0	AS REQD
②	30006509	CONNECTOR, TAP COMP, 6AWG – 4AWG	1
③	30014480	BARE COND, COPPER, 4AWG, 7 STRAND, SD	AS REQD
④	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
⑤	AS REQD	CONNECTOR, TAP WEDGE	AS REQD
⑥	AS REQD	CONNECTOR, STIRRUP, BOLTED	1
⑦	30007392	CONNECTOR, LIVE LINE	1
⑧	30008425	INSULATOR, STANDOFF 28 kV	MAX 1
⑨	30000770	CLAMP REST, INSULATOR TYPE	MAX 1
⑩	30008041	SUPPORT, CABLE & TERMINATION	1
⑪	30008331	TAPE, ELECTRICAL, PVC, BLACK	AS REQD
⑫	30010073 30010074 30010075	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME––WHITE SAME––BLUE	AS REQD
⑬	30000825	BRACKET, CUTOUT & ARRESTER	1
⑭	AS REQD	SURGE ARRESTER, RISER POLE	1
⑮	30007446	TERMINATION, COLD SHRINK, 28 kV, 1/0	1
⑯	30013881	STAPLE, GROUND WIRE, 3/8" x 1–1/2"	AS REQD
⑰	30000777	CLAMP REST, POLE TYPE	1
⑱	30003502	CLAMP, GEAR TYPE	1
⑲	AS REQD	BOLT, 3/4" DIA.	AS REQD
⑳	30001595	WASHER, SQUARE, 3/4" x 2" x 2"	AS REQD

NOTES (CONTINUED):
14. FOR CABLES WITH BOTH CONCENTRIC NEUTRAL AND ARMOR WIRE, THE ARMOR WIRE SHALL BE REMOVED APPROXIMATELY MID–WAY BETWEEN THE BASE OF THE TERMINATION AND THE TOP OF THE CABLE GUARD. A WORM GEAR TYPE HOSE CLAMP SHALL BE INSTALLED AND TIGHTENED AROUND THE ARMOUR AT THIS POINT. THE ARMOUR STRANDS ABOVE THE CLAMP SHALL BE UNRAVELED AND BENT BACK OVER THE CLAMP AND COLLECTED ON ONE SIDE OF THE CABLE. THE COLLECTED STRANDS SHALL BE JOINED TO A LENGTH OF 1/0 BARE COPPER CONDUCTOR WITH AN APPROPRIATE CONNECTOR.

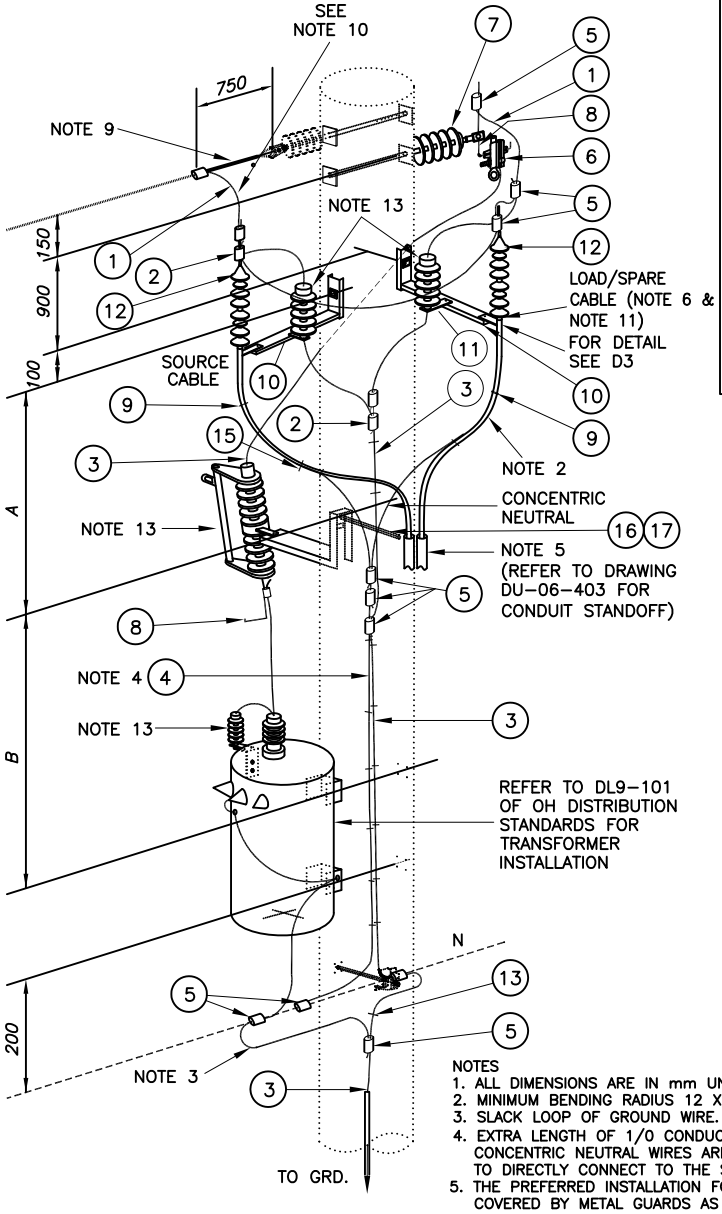
Rev. No.	Issue Date	Revision	Dwn	Approved By Date
*	* *	* *	*	
02	NOV 2011	REDRAWN WITH EDITORIAL CHANGES AND REDRAWN DETAIL 3	PC *	

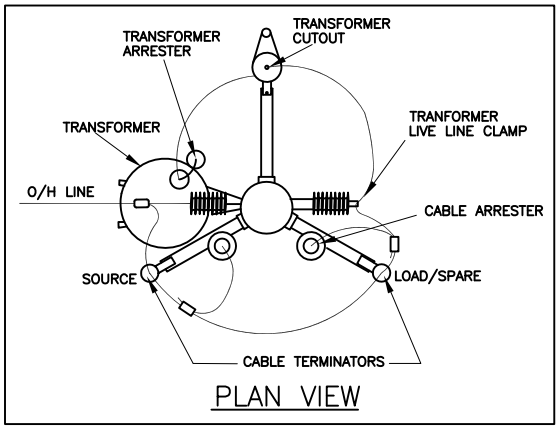
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

UNFUSED PRIMARY SUBMARINE CABLE TERMINATION
- 1 PHASE, 2.4 TO 16 kV

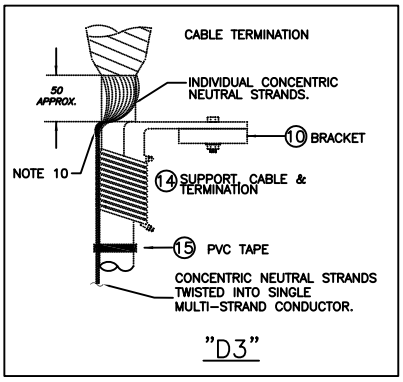
Dwg. No. DU-06-102 SH. 2 OF 2 Rev. 02





PLAN VIEW

PART #	MM #	DESCRIPTION	QTY.
①	30005821 30005823 30005825	BARE COND, COPPER, 1/0 AWG, MHD SAME--2/0 SAME--4/0	AS REQD
②	30006509	CONNECTOR, TAP COMP, 6AWG – 4AWG	1
③	30014480	BARE COND, COPPER, 4AWG, 7 STRAND, SD	AS REQD
④	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
⑤	AS REQD	CONNECTOR, TAP WEDGE	AS REQD
⑥	30007392	CONNECTOR, LIVE LINE	1
⑦	30008425	INSULATOR, STANDOFF 28 kV	1
⑧	30000770	CLAMP REST, INSULATOR TYPE	2
⑨	30010073 30010074 30010075	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	AS REQD
⑩	30000825	BRACKET, CUTOUT & ARRESTER	2
⑪	AS REQD	SURGE ARRESTER, RISER POLE	2
⑫	30007446	TERMINATION, COLD SHRINK, 28 kV, 1/0	2
⑬	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	AS REQD
⑭	30008041	SUPPORT, CABLE AND TERMINATION	2
⑮	30008331	TAPE, ELECTRICAL, PVC, BLACK	AS REQD
⑯	AS REQD	BOLT, 3/4" DIA.	AS REQD
⑰	30001595	WASHER, SQUARE, 3/4" x 2" x 2"	AS REQD



"D3"

NOTES
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
3. SLACK LOOP OF GROUND WIRE.
4. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
5. THE PREFERRED INSTALLATION FOR CABLES ON A POLE IS COVERED BY METAL GUARDS AS PER DU-08-302. STANDOFF BRACKETS MAY BE USED WHERE AERIAL DEVICE ACCESS IS UNAVAILABLE. REFER TO DU-06-403.
6. THIS IS A NON-PREFERRED INSTALLATION. THE PREFERRED INSTALLATION IS PAD-MOUNTED TRANSFORMER AND PAD-MOUNTED KIOSK. THIS CABLE MAY BE SUPPLYING A LOAD OR COULD BE A SPARE CABLE.
7. FOLD BACK, BUNDLE TOGETHER, ATTACH TO CABLE BY TAPE, AND THEN CONNECT TO NEUTRAL.
8. FOR EXPOSED ENDS OF PE COVERED STEEL ARMOURED (M-695) CABLE, ALWAYS SUSPEND CABLE POINTING DOWNWARDS TO STOP MOISTURE INGRESS.
9. FUSED CUTOUT/SWITCH (IF REQUIRED) LOCATED ON ADJACENT POLE – SEE DL8-103.
10. JUMPER AMPACITY SHOULD AT LEAST EQUAL CABLE AMPACITY.
11. O/H DISTRIBUTION TRANSFORMER FRAMING (DL9-101), MAY BE OMITTED – CABLE CONFIGURATION REMAINS THE SAME. IN SOME INSTANCES THE TRANSFORMER OR THE SECOND LOAD/SPARE CABLE MAY NOT BE REQUIRED.
12. OTHER END OF THE PRIMARY SUBMARINE CABLE MUST HAVE FUSED PROTECTION.
13. REFER TO OVERHEAD DISTRIBUTION STANDARDS – SECTION 8 FOR CUTOUT AND ARRESTER SELECTION.

SYSTEM VOLTAGE 1ø	MINIMUM DIMENSIONS	
	A	B
2.4 TO 8KV	1200	600
14.4 AND 16KV	1500	750

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
150	6"
200	8"
250	10"
600	2'-0"
750	2'-6"
1200	3'-9"
1500	5'-0"

REFERENCES:

SECTION 1	DEFINITIONS
SECTION 6C	CONSTRUCTION GUIDE
SECTION 8	O/H DIST. STANDARDS
SECTION 9	O/H DIST. STANDARDS
SECTION 16	MATERIALS LIST

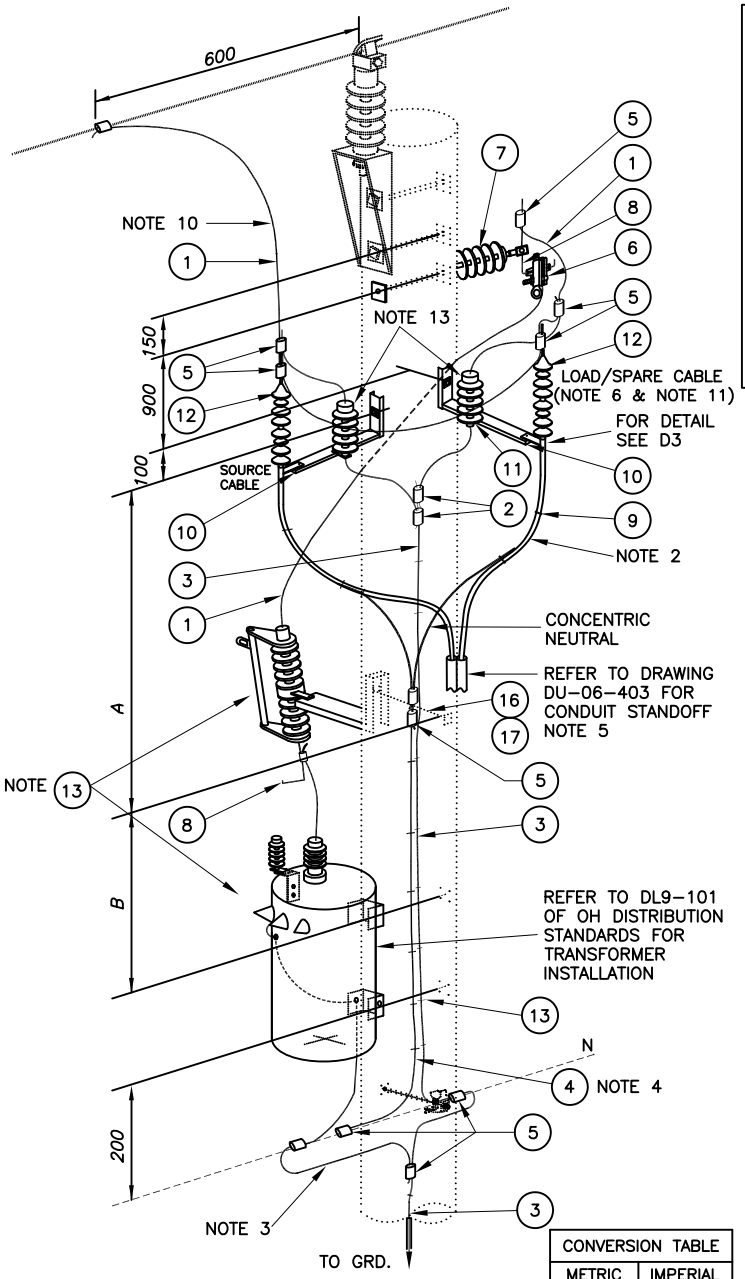
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
02	NOV 2011	REDRAWN DETAIL D3 *	* / *	
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	* / *	

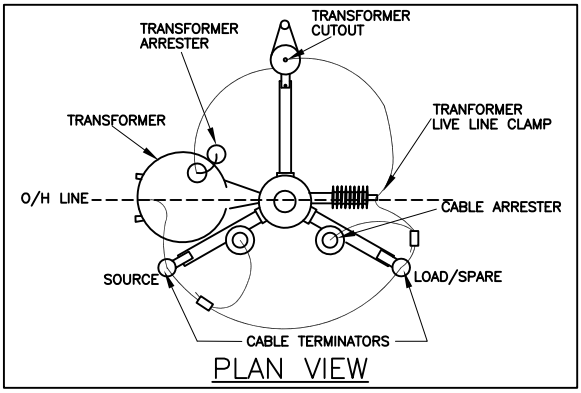
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	*

TRANSFORMER AND SUBMARINE CABLES ON THE SAME POLE - 1 PHASE, 2.4 TO 16 kV - DEAD END

Dwg. No. DU-06-103 Rev. 02





PLAN VIEW

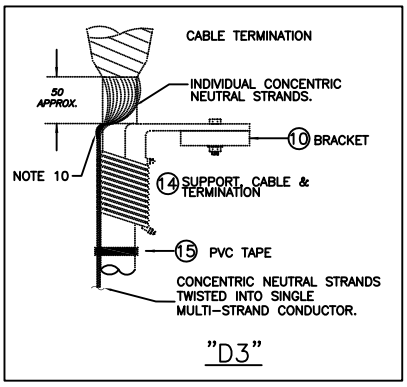
PART #	MM #	DESCRIPTION	QTY.
1	30005821 30005823 SAME--2/0 30005825 SAME--4/0	BARE COND, COPPER, 1/0 AWG, MHD	AS REQD
2	30006509	CONNECTOR, TAP COMP, 6AWG – 4AWG	1
3	30014480	BARE COND, COPPER, 4AWG, 7 STRAND, SD	AS REQD
4	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
5	AS NEEDED	CONNECTOR, TAP WEDGE	AS REQD
6	30007392	CONNECTOR, LIVE LINE	1
7	30008425	INSULATOR, STANDOFF 28 kV	1
8	30000770	CLAMP REST, INSULATOR TYPE	2
9	30010073 30010074 SAME--WHITE 30010075 SAME--BLUE	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE	AS REQD
10	30000825	BRACKET, CUTOUT & ARRESTER	2
11	AS REQD	SURGE ARRESTER, RISER POLE	2
12	30007446	TERMINATION, COLD SHRINK, 28 kV, 1/0	2
13	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	AS REQD
14	30008041	SUPPORT, CABLE AND TERMINATION	2
15	30008331	TAPE, ELECTRICAL, PVC, BLACK	AS REQD
16	AS REQD	BOLT, 3/4" DIA.	AS REQD
17	30001595	WASHER, SQUARE, 3/4" x 2" x 2"	AS REQD

NOTES
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
3. SLACK LOOP OF GROUND WIRE.
4. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
5. THE PREFERRED INSTALLATION FOR CABLES ON A POLE IS COVERED BY METAL GUARDS AS PER DU-08-302. STANDOFF BRACKETS MAY BE USED WHERE AERIAL DEVICE ACCESS IS UNAVAILABLE AS PER DU-06-403.
6. THIS IS A NON-PREFERRED INSTALLATION. THE PREFERRED INSTALLATION IS PAD-MOUNTED TRANSFORMER AND PAD-MOUNTED KIOSK. THIS CABLE MAY BE SUPPLYING A LOAD OR COULD BE A SPARE CABLE.
7. FOLD BACK, BUNDLE TOGETHER, ATTACH TO CABLE BY TAPE, AND THEN CONNECT TO NEUTRAL.
8. FOR EXPOSED ENDS OF PE COVERED STEEL ARMOURED (M-695) CABLE, ALWAYS SUSPEND CABLE POINTING DOWNWARDS TO STOP MOISTURE INGRESS.
9. FUSED CUTOUT/SWITCH (IF REQUIRED) LOCATED ON ADJACENT POLE – SEE DL8-103.
10. JUMPER AMPACITY SHOULD AT LEAST EQUAL CABLE AMPACITY.
11. O/H DISTRIBUTION TRANSFORMER FRAMING (DL9-101), MAY BE OMITTED – CABLE CONFIGURATION REMAINS THE SAME. IN SOME INSTANCES THE TRANSFORMER OR THE SECOND LOAD/SPARE CABLE MAY NOT BE REQUIRED.
12. ONE END OF THE PRIMARY SUBMARINE CABLE MUST HAVE FUSED PROTECTION.
13. REFER TO OVERHEAD DISTRIBUTION STANDARDS – SECTION 8 FOR CUTOUT AND ARRESTER SELECTION.

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 8,9 O/H DIST. STANDARDS
SECTION 16 MATERIALS LIST

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
150	6"
200	8"
250	10"
600	2'-0"
750	5'-0"
1200	3'-9"
1500	5'-0"

SYSTEM VOLTAGE 1ø	MINIMUM DIMENSIONS	
	A	B
2.4 TO 8KV	1200	600
14.4 AND 16KV	1500	750



"D3"

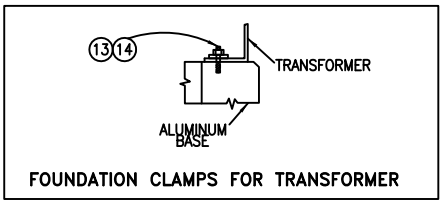
Rev. No.	Issue Date	Revision	Dwn	Approved By
02	NOV 2011	REDRAWN DETAIL D3 *		
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES		
			Chk	Date

hydro one **Hydro One Networks Inc.**

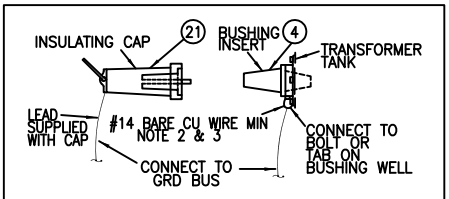
Drawn:	Approved:	Date:
A. VIDAD	*	*

TRANSFORMER AND SUBMARINE CABLES ON THE SAME POLE - 1 PHASE, 2.4 TO 16 kV - TANGENT

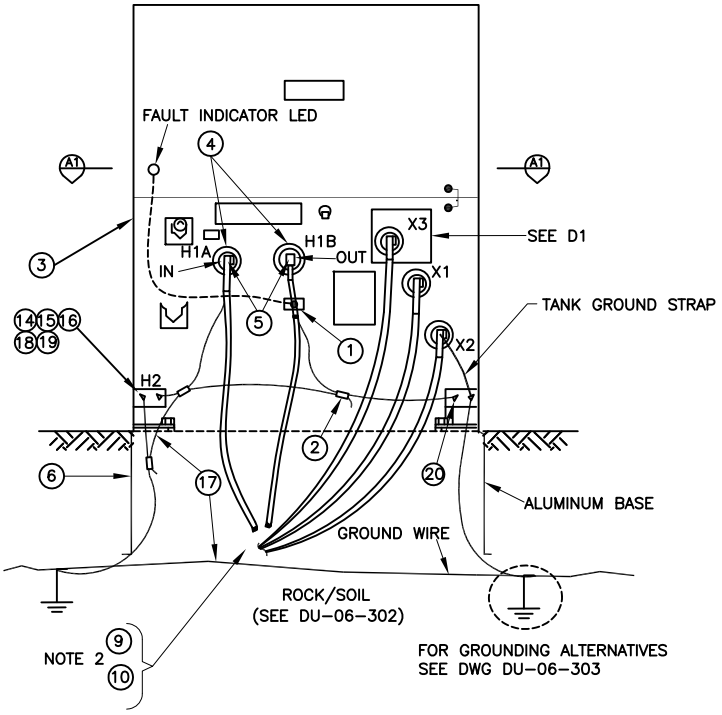
Dwg. No. DU-06-103A Rev. 02

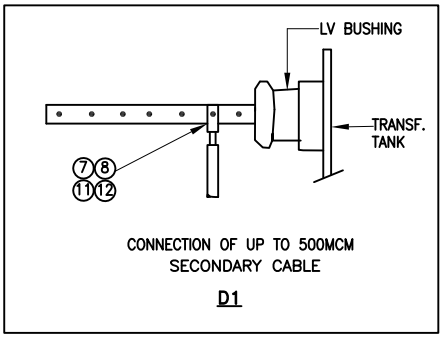


FOUNDATION CLAMPS FOR TRANSFORMER



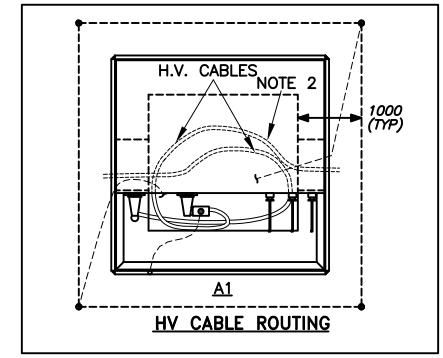
GROUNDING OF INSULATING CAP AND/OR BUSHING INSERT





CONNECTION OF UP TO 500MCM SECONDARY CABLE

D1



HV CABLE ROUTING

PART #	MM #	DESCRIPTION	QTY.
①	A/R	FAULT INDICATOR	1
②	30006154	CONNECTOR, TAP BLTD COND TO COND	3
③	A/R	MICROPAD TRANSFORMER	1
④	30007479	BUSHING INSERT	2
⑤	30007475	ELBOW, LOADBREAK, 28 kV, 1/0, 200 A	2
		A/R = AS REQUIRED	

PART #	MM #	DESCRIPTION	QTY.
⑥	30011213 –	ALUMINUM BASE – 25 kVA FOR MICROPAD TRANSFORMER – LOW PROFILE ALUMINUM BASE – 25 kVA FOR MICROPAD TRANSFORMER – HIGH PROFILE	1
⑦	30007238	CONNECTOR – UP TO 250 kCMIL CONNECTOR	A/R
⑧	30007239	CONNECTOR – UP TO 500 kCMIL CONNECTOR	A/R
⑨	A/R	DUCT PVC, RIGID	A/R
⑩	A/R	DUCT PVC, BEND	A/R
⑪	30001243	BOLT, GALV, HEX HEAD, 9.5MM, 38.1MM LONG	3 MIN
⑫	30001628	WASHER, LOCK – 9.5 mm BOLT	3 MIN
⑬	10000081	BOLT, HEX HEAD GALV GR2, 1/2" DIA, 1" LG	4
⑭	30001605	WASHER, LOCK HELICAL SPRING, 1/2" BOLT,	4
⑮	30001184	BOLT, 1/2" DIA, 1–1/2" LG, SI–BR	5
⑯	30006864	CONNECTOR, TERM, COMP PAD, 12mm HOLE	1
⑰	30014480	BARE COND, COPPER, 4AWG	3m
⑱	30001499	NUT, 1/2", SI–BR	5
⑲	30001681	WASHER, 1/2", SI–BR	5
⑳	30006431	CONNECTOR, COMPRESSION, FOR CN WIRES	2
㉑	30007478	CAP, UGRD, INSULATING, 28kV	1 MAX

NOTES:

1. SECONDARY CABLE CONDUCTORS ARE IDENTIFIED BY USE OF COLOURED JACKET
   NEUTRAL: [X2] – WHITE
   PHASES: [X1] – RED
   [X3] – BLACK
2. PRIMARY AND SECONDARY CABLES ENTERING THE TRANSFORMER BASE TO BE ENCASED SUITABLY IN PVC DUCTS TO 100 MM ABOVE GRADE IN TRANSFORMER BASE (THIS MAY REQUIRE CURVED DUCT). CABLE MUST BE "TRAINED" IN SUCH A WAY TO ALLOW SAFE REMOVAL OF ELBOW WITH LIVE LINE TOOLS.
3. IF MECHANICAL PROTECTION OF SUBMARINE CABLE FROM WATER'S EDGE TO POLE OR TRANSFORMER IS REQUIRED, CABLE SHOULD BE COVERED BY A MINIMUM THICKNESS OF CONCRETE OF 75 MM WITH A MINIMUM STRENGTH OF 20 MPA AFTER 28 DAYS C/W AIR ENTRAINMENT. (IF CONCRETE TO BE BURIED, AIR IS NOT NEEDED). MAXIMUM AGGREGATE SIZE OF 20 MM.

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 16 MATERIALS LIST

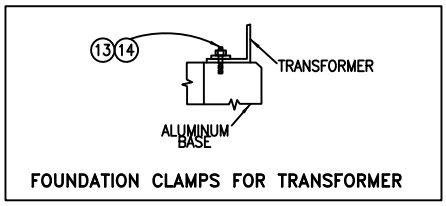
Rev. No.	Date	Revision	Dwn	Approved By	Date
02	NOV 2011	FOUR GROUND RODS AND GROUNDING DETAILS	*	*	
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	*	*	

hydro one **Hydro One Networks Inc.**

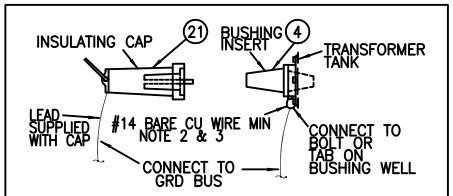
Drawn:	Approved:	Date:
A. VIDAD	*	NOV 10, 2011

MICROPAD TRANSFORMER INSTALLATION, UP TO 25 kVA
1 PHASE 2.4 TO 14.4 kV

Dwg. No. DU-06-301 Rev. 02



FOUNDATION CLAMPS FOR TRANSFORMER



GROUNDING OF INSULATING CAP AND/OR BUSHING INSERT

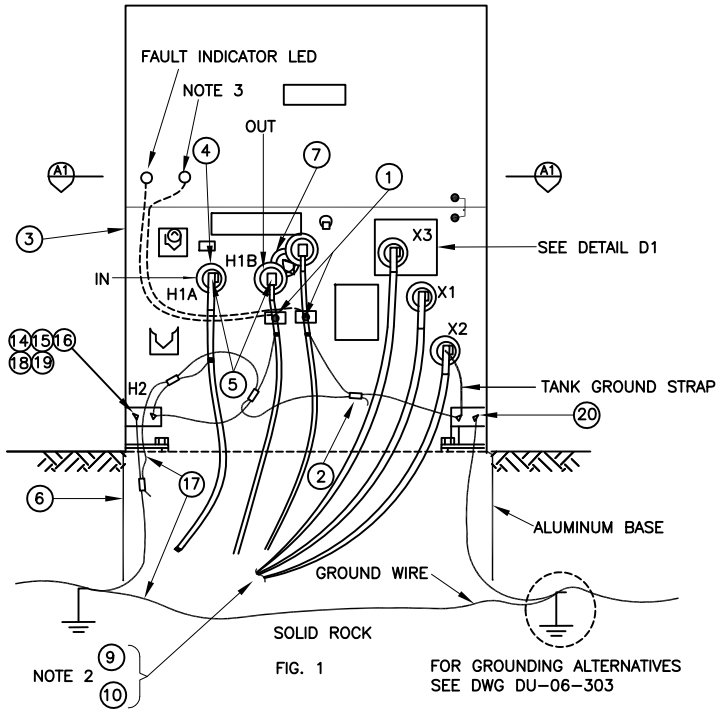
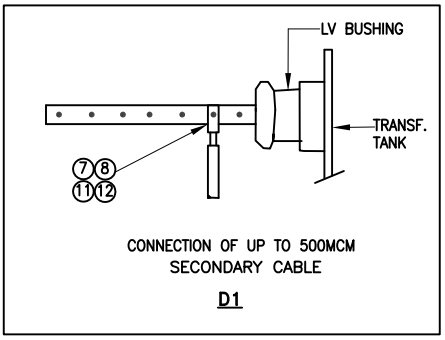


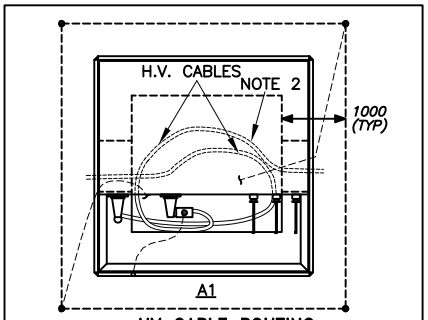
FIG. 1

FOR GROUNDING ALTERNATIVES SEE DWG DU-06-303



CONNECTION OF UP TO 500MCM SECONDARY CABLE

D1



HV CABLE ROUTING

PART #	MM #	DESCRIPTION	QTY.
①	A/R	FAULT INDICATOR	1
②	30006154	CONNECTOR, TAP BLTD COND TO COND	3
③	A/R	MICROPAD TRANSFORMER	1
④	30007479	BUSHING INSERT	2
⑤	30007475	ELBOW, LOADBREAK, 28 kV, 1/0, 200 A	2

PART #	MM #	DESCRIPTION	QTY.
⑥	30011213 –	ALUMINUM BASE – 25 kVA FOR MICROPAD TRANSFORMER – LOW PROFILE ALUMINUM BASE – 25 kVA FOR MICROPAD TRANSFORMER – HIGH PROFILE	1
⑦	30007238	CONNECTOR – UP TO 250 kCMIL CONNECTOR	A/R
⑧	30007239	CONNECTOR – UP TO 500 kCMIL CONNECTOR	A/R
⑨	A/R	DUCT PVC, RIGID	A/R
⑩	A/R	DUCT PVC, BEND	A/R
⑪	30001243	BOLT, GALV, HEX HEAD, 9.5MM, 38.1MM LONG	3 MIN
⑫	30001628	WASHER, LOCK – 9.5 mm BOLT	3 MIN
⑬	10000081	BOLT, HEX HEAD GALV GR2, 1/2" DIA, 1" LG	4
⑭	30001605	WASHER, LOCK HELICAL SPRING, 1/2" BOLT,	4
⑮	30001184	BOLT, 1/2" DIA, 1-1/2" LG, SI-BR	5
⑯	30006864	CONNECTOR, TERM, COMP PAD, 12mm HOLE	1
⑰	30014480	BARE COND, COPPER, 4AWG	3m
⑱	30001499	NUT, 1/2", SI-BR	5
⑲	30001681	WASHER, 1/2", SI-BR	5
⑳	30006431	CONNECTOR, COMPRESSION, FOR CN WIRES	2
㉑	30007478	CAP, UGRD, INSULATING, 28kV	A/R
		A/R = AS REQUIRED	

NOTES:

1. SECONDARY CABLE CONDUCTORS ARE IDENTIFIED BY USE OF COLOURED JACKET
   NEUTRAL: [X2] – WHITE
   PHASES: [X1] – RED
   [X3] – BLACK
2. PRIMARY AND SECONDARY CABLES ENTERING THE TRANSFORMER BASE TO BE ENCASED SUITABLY IN PVC DUCTS TO 100 mm ABOVE GRADE IN TRANSFORMER BASE (THIS MAY REQUIRE CURVED DUCT). CABLE MUST BE "TRAINED" IN SUCH A WAY TO ALLOW SAFE REMOVAL OF ELBOW WITH LIVE LINE TOOLS.
3. FIELD DRILLED HOLE FOR SECOND LED – ROUTE LED LEADS CAREFULLY TO FACILITATE TRANSFORMER LID OPENING.
4. IF MECHANICAL PROTECTION OF SUBMARINE CABLE FROM WATER'S EDGE TO POLE OR TRANSFORMER IS REQUIRED, CABLE SHOULD BE COVERED BY A MINIMUM THICKNESS OF CONCRETE OF 75 MM WITH A MINIMUM STRENGTH OF 20 MPA AFTER 28 DAYS C/W AIR ENTRAINMENT. (IF CONCRETE TO BE BURIED, AIR IS NOT NEEDED). MAXIMUM AGGREGATE SIZE OF 20 mm.

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 16 MATERIALS LIST

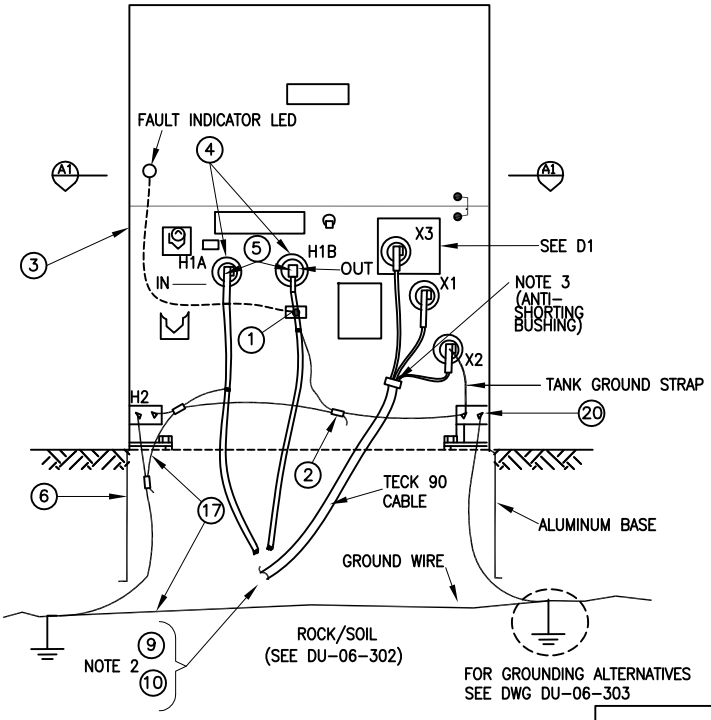
Rev. No.	Issue Date	Revision	Dwn	Approved By	Date
02	NOV 2011	FOUR GROUND RODS AND GROUNDING DETAILS	*	*	
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	*	*	

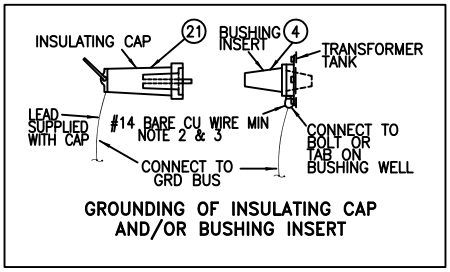
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	NOV.10,2011

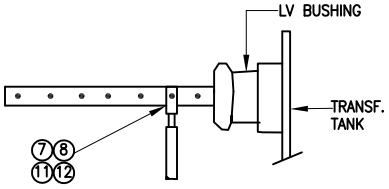
MICROPAD TRANSFORMER, UP TO 25 kVA,
1 PHASE, 2.4 - 14.4 kV, 2 LOAD SIDE
PRIMARY SUB. CABLE

Dwg. No. DU-06-301A Rev. 02



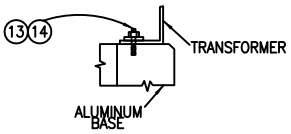


GROUNDING OF INSULATING CAP AND/OR BUSHING INSERT

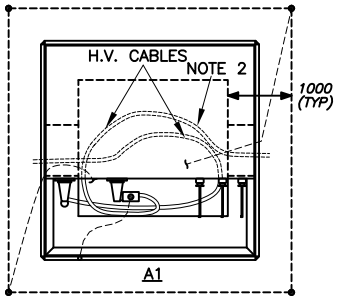


CONNECTION OF UP TO 500MCM SECONDARY CABLE

D1



FOUNDATION CLAMPS FOR TRANSFORMER



HV CABLE ROUTING

PART #	MM #	DESCRIPTION	QTY.
①	A/R	FAULT INDICATOR	1
②	30006154	CONNECTOR, TAP BLTD COND TO COND	3
③	A/R	MICROPAD TRANSFORMER	1
④	30007479	BUSHING INSERT	2
⑤	30007475	ELBOW, LOADBREAK, 28 kV, 1/0, 200 A	2
		A/R = AS REQUIRED	

NOTES:

1. SECONDARY CABLE CONDUCTORS ARE IDENTIFIED BY USE OF COLOURED JACKET
   NEUTRAL: [X2] – WHITE
   PHASES: [X1] – RED
   [X3] – BLACK
2. PRIMARY AND SECONDARY CABLES ENTERING THE TRANSFORMER BASE TO BE ENCASED SUITABLY IN PVC DUCTS TO 100 mm ABOVE GRADE IN TRANSFORMER BASE (THIS MAY REQUIRE CURVED DUCT). CABLE MUST BE "TRAINED" IN SUCH A WAY TO ALLOW SAFE REMOVAL OF ELBOW WITH LIVE LINE TOOLS.
3. THE GROUNDING CONDUCTOR SHALL BE CONNECTED TO THE CLOSEST AVAILABLE GROUND AT THE SUPPLY END AND TO THE METER BOX FRAME GROUND AT THE LOAD END. ANTI SHORTING INSULATED BUSHINGS ARE REQUIRED TO TERMINATE EACH END OF THE TECK 90 ARMOURED CABLE (TECK 90 CABLE AND ITS ACCESSORIES ARE CUSTOMER SUPPLIED).
4. IF MECHANICAL PROTECTION OF SUBMARINE CABLE FROM WATER'S EDGE TO POLE OR TRANSFORMER IS REQUIRED, CABLE SHOULD BE COVERED BY A MINIMUM THICKNESS OF CONCRETE OF 75 MM WITH A MINIMUM STRENGTH OF 20 MPA AFTER 28 DAYS C/W AIR ENTRAINMENT. (IF CONCRETE TO BE BURIED, AIR IS NOT NEEDED). MAXIMUM AGGREGATE SIZE OF 20 mm.

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 16 MATERIALS LIST

PART #	MM #	DESCRIPTION	QTY.
⑥	30011213 –	ALUMINUM BASE – 25 kVA FOR MICROPAD TRANSFORMER – LOW PROFILE ALUMINUM BASE – 25 kVA FOR MICROPAD TRANSFORMER – HIGH PROFILE	1
⑦	30007238	CONNECTOR – UP TO 250 kCMIL CONNECTOR	A/R
⑧	30007239	CONNECTOR – UP TO 500 kCMIL CONNECTOR	A/R
⑨	A/R	DUCT PVC, RIGID	A/R
⑩	A/R	DUCT PVC, BEND	A/R
⑪	30001243	BOLT, GALV, HEX HEAD, 9.5MM, 38.1MM LONG	3 MIN
⑫	30001628	WASHER, LOCK – 9.5 mm BOLT	3 MIN
⑬	10000081	BOLT, HEX HEAD GALV GR2, 1/2" DIA, 1" LG	4
⑭	30001605	WASHER, LOCK HELICAL SPRING, 1/2" BOLT,	4
⑮	30001184	BOLT, 1/2" DIA, 1–1/2" LG, SI–BR	5
⑯	30006864	CONNECTOR, TERM, COMP PAD, 12mm HOLE	1
⑰	30014480	BARE COND, COPPER, 4AWG	3m
⑱	30001499	NUT, 1/2", SI–BR	5
⑲	30001681	WASHER, 1/2", SI–BR	5
⑳	30006431	CONNECTOR, COMPRESSION, FOR CN WIRES	2
㉑	30007478	CAP, UGRD, INSULATING, 28kV	A/R

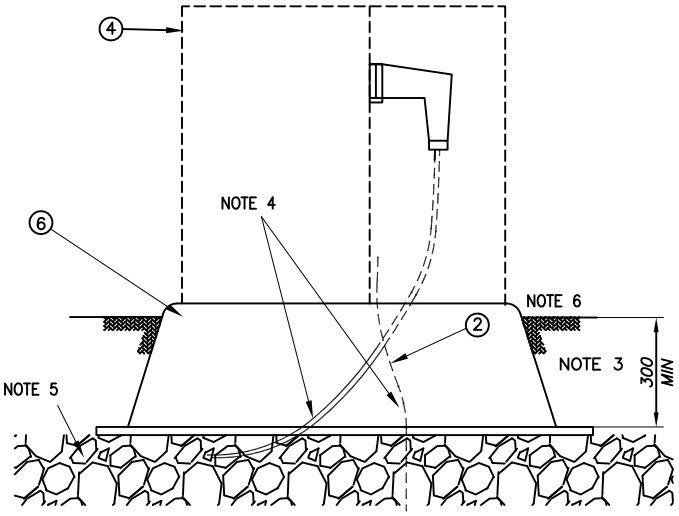
Rev. No.	Issue Date	Revision	Dwn	Approved By	Date
02	NOV 2011	FOUR GROUND RODS AND GROUNDING DETAILS	*	*	
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	*	*	

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	NOV.03,2011

MICROPAD TRANSFORMER INSTALLATION
(WITH TECK CABLE),
UP TO 25 kVA, 1 PHASE 2.4 TO 14.4 kV

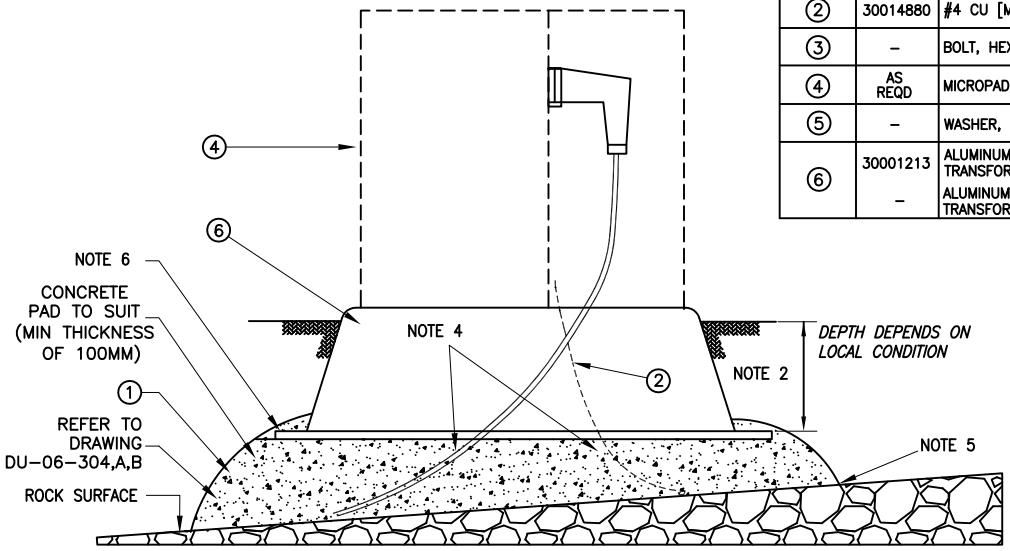
Dwg. No. DU-06-301B Rev. 02



ALUMINUM BASE ON EARTH

FIG. 1

PART #	MM #	DESCRIPTION	QTY.
1	–	CONCRETE LEVELLING PAD	AS REQ
2	30014880	#4 CU [MIN]	AS REQ
3	–	BOLT, HEX HEAD GALV GR2, 1/2" DIA	4
4	AS REQD	MICROPAD TRANSFORMER OR KIOSK	1
5	–	WASHER, LOCK HELICAL SPRING, 1/2" BOLT	4
6	30001213 –	ALUMINUM BASE FOR MICROPAD TRANSFORMER – 300 mm ALUMINUM BASE FOR MICROPAD TRANSFORMER – 600 mm	1

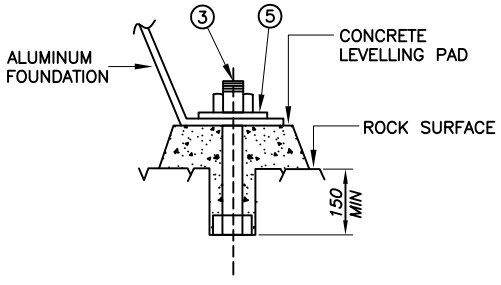


CONCRETE LEVELLING PAD ON ROCK

FIG. 2

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. BASE MUST NOT BE LOCATED ON SOLID ROCK WITHOUT SOME EARTH OR CONCRETE COVERAGE. LOOSE SLABS MUST BE REMOVED. THE ROCK SHOULD HAVE A MINIMUM SLOPE OR NATURAL CREVICES TO PROVIDE A RESTRAINING EFFECT.
3. IF EARTH OVERBURDEN IS LESS THAN 300 mm DEEP, ANCHOR BASE AND CONCRETE LEVELING PAD ON ROCK SURFACE – SEE D2.
4. CABLES INSTALLED IN PVC DUCT
5. 150 mm THICK LAYER OF GRANULAR "A" (GRAVEL) SHALL BE PROVIDED UNDER BASE FOR LEVELLING AND STABILITY IF REQUIRED.
6. THE TOP OF THE BASE IS TO BE AT LEAST 100 mm ABOVE GRADE
7. IF MECHANICAL PROTECTION OF SUBMARINE CABLE FROM WATER'S EDGE TO POLE OR TRANSFORMER IS REQUIRED, CABLE SHOULD BE COVERED BY A MINIMUM THICKNESS OF CONCRETE OF 75 MM WITH A MINIMUM STRENGTH OF 20 MPA AFTER 28 DAYS C/W AIR ENTRAINMENT. (IF CONCRETE TO BE BURIED, AIR IS NOT NEEDED). MAXIMUM AGGREGATE SIZE OF 20 mm.

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 16 MATERIALS LIST



D2
ANCHORING FOUNDATION & PAD ON ROCK

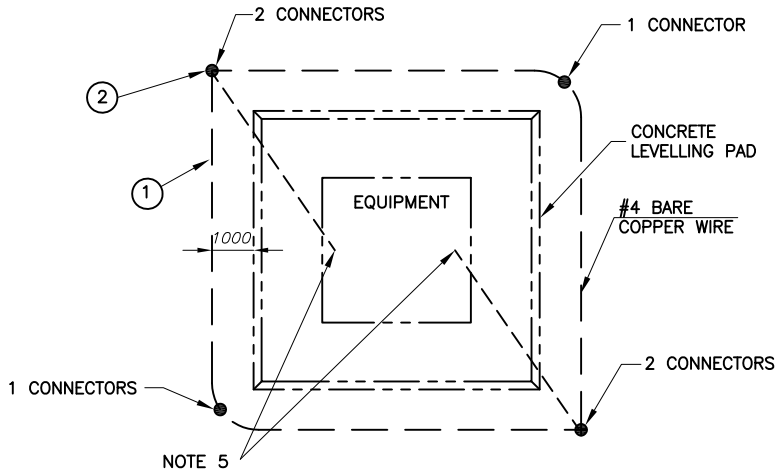
Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	* *	* *	*	*		
02	NOV 2011	FIG. 1 TITLE CHANGE AND PARTS REVISION	*	*		

hydro one **Hydro One Networks Inc.**

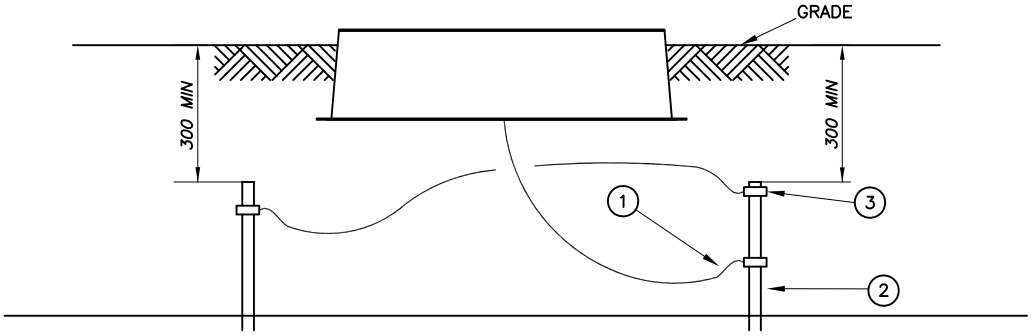
Drawn:	Approved:	Date:
A. VIDAD	*	OCT.31,2011

TRANSFORMER AND/OR KIOSK BASE INSTALLATION IN EARTH OR ON ROCK - ALUMINUM BASE

Dwg. No. DU-06-302 Rev. 02



PLAN VIEW OF GROUND GRADIENT GRID



TYPICAL GROUND RODS

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 16 MATERIALS LIST

SEE SH. 2 FOR NOTES & MATERIAL LIST.

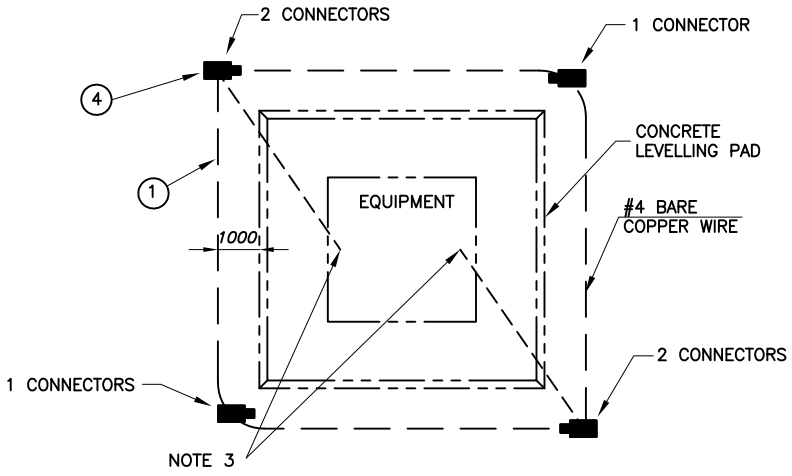
Rev. No.	Issue Date	Revision	Dwn	Approved By Date
02	NOV 2011	SPECIFIED FOUR GROUND RODS/ PLATES AND NOTE CHANGES	*	*
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	*	*

hydro one **Hydro One Networks Inc.**

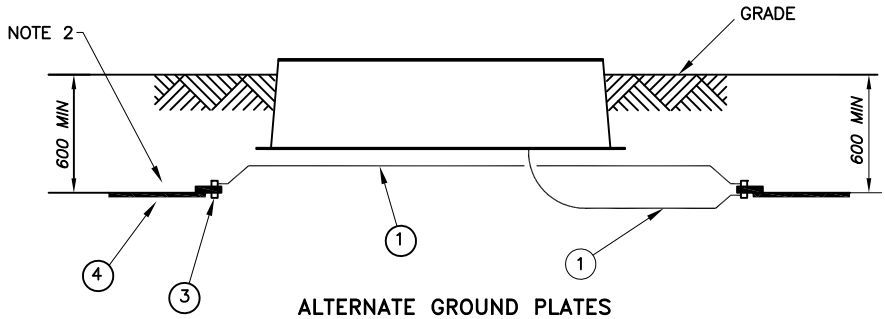
Drawn:	Approved:	Date:
S.OORT	*	NOV.07,2011

MICROPAD EQUIPMENT GROUNDING DETAILS
- TYPICAL AND ALTERNATE ARRANGEMENTS

Dwg. No. DU-06-303 SHT. 1 OF 2 Rev. 02



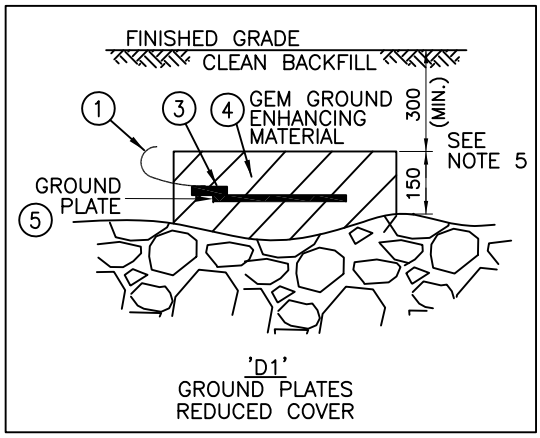
PLAN VIEW OF GROUND GRADIENT GRID



ALTERNATE GROUND PLATES

PART #	MM#	DESCRIPTION	QTY.
1	30014488	BARE COND, COPPER, #4 AWG	A/R
2	30014142	ROD, GROUND, 3/4" x 10ft, GALVANIZED	4
3	30006646	CONNECTOR, GRD WEDGE, GROUND ROD TO #4 COPPER WIRE	6
4	30025402	GEM MATERIAL	A/R
5	30025401	GROUND PLATE	4

A/R – AS REQUIRED



'D1'
GROUND PLATES
REDUCED COVER

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. GROUND RODS MAY BE SUBSTITUTED WITH GROUND PLATES ONLY IF GROUND RODS CANNOT BE DRIVEN DUE TO ROCKY GROUND CONDITIONS. MAINTAIN 600mm MINIMUM NATIVE SOIL COVER OVER PLATES AND 300mm OVER GROUND WIRE(S) PLATES INSTALLED AT REDUCED DEPTH MUST BE INSTALLED PER INSET 'D1'
3. LEAVE 2 m COIL OF #4 WIRE IN FOUNDATION FOR FINAL CONNECTION TO EQUIPMENT.
4. FOR LOCATIONS HAVING BALD ROCK, INSTALL GROUND WIRES IN CREVICES, AND/OR COVER WITH EARTH, GEM OR ROCK
5. MECHANICAL PROTECTION (75mm 21 MPa CONCRETE) IS REQUIRED OVER PLATES AND GROUND WIRES FOR BURIAL DEPTHS LESS THAN 300mm.
6. EACH GROUND PLATE (IF REQUIRED) REQUIRES ONE BAG OF GEM (MINIMUM). PLATE TO BE CENTRED WITHIN MIXTURE.

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 16 MATERIALS LIST

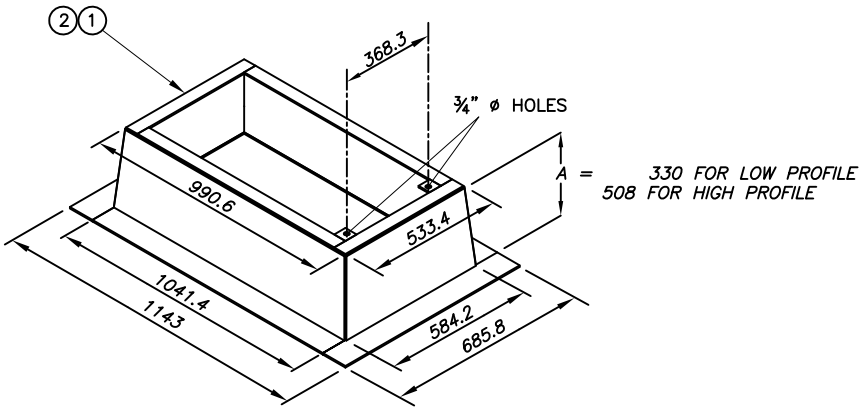
Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
02	NOV 2011	SPECIFIED FOUR GROUND RODS/ PLATES AND NOTE CHANGES	SO	*		
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	*	*		

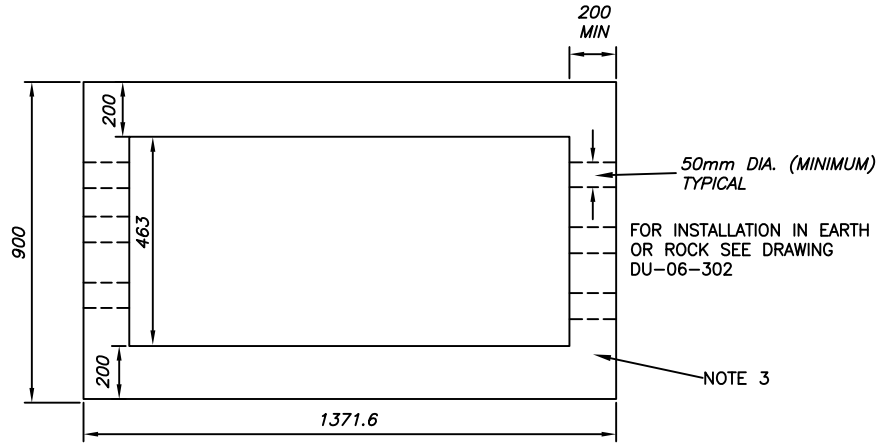
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV.07,2011

MICROPAD EQUIPMENT GROUNDING DETAILS
- TYPICAL AND ALTERNATE ARRANGEMENTS

Dwg. No. DU-06-303 SHT. 2 OF 2 Rev. 02





FIELD POURED CONCRETE LEVELLING PAD FOR MICROPAD

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
76.2	3"
82.6	3¼"
200	8"
330	1'–1"
368.3	1'–2 ½"
508	1'–8"
533.4	1'–9"
584.2	1'–11"
685.8	2'–3"
900	3'–0"
990.6	3'–3"
1041.4	3'–5"
1143	3'–9"
1371.6	4'–6"

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. TOP & BOTTOM DIMENSIONS OF ALUMINUM BASE REMAIN THE SAME FOR BOTH LOW AND HIGH PROFILE MODELS
3. CONCRETE

PART #	MM #	DESCRIPTION	QTY.
①	30011213	ALUMINUM BASE – 25 kVA FOR MICROPAD TRANSFORMER – LOW PROFILE	1
②	–	ALUMINUM BASE – 25 kVA FOR MICROPAD TRANSFORMER – HIGH PROFILE	1

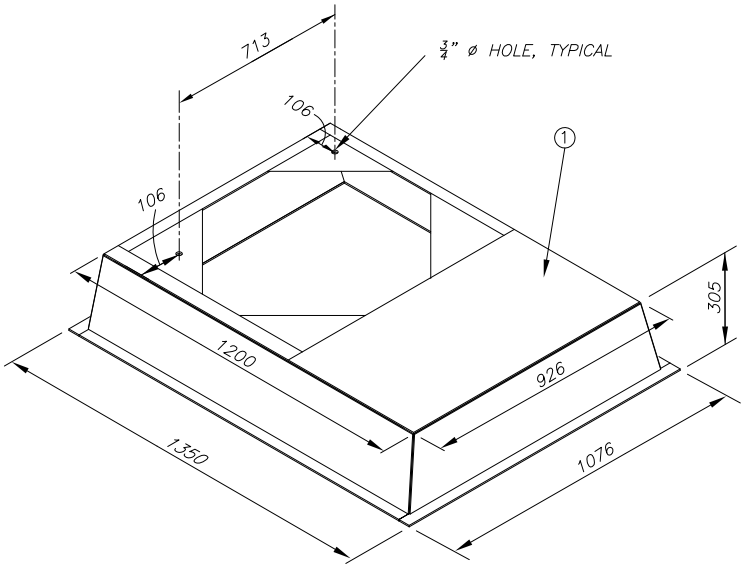
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
*	* *	*	*	
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	*	*

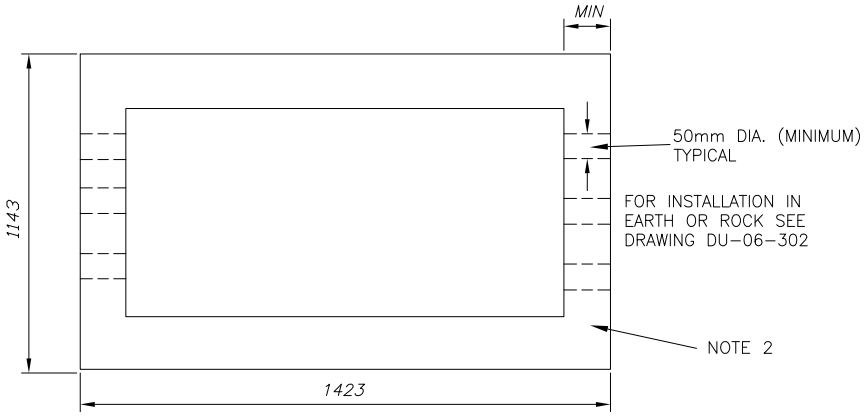
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	*

ALUMINUM BASE - MICROPAD TRANSFORMER

Dwg. No. DU-06-304 Rev. 01





FIELD POURED CONCRETE LEVELLING PAD FOR PADMOUNT TRANSFORMER

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
106	4¼"
200	8"
250	10"
290	11⅜"
500	1'-8"
713	2'-4"
926	3'-1"
976	3'-3"
1076	3'-7"
1143	3'-9"
1200	4'-0"
1250	4'-2"
1350	4'-6"
1423	4'-8"

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. CONCRETE

PART #	MM #	DESCRIPTION	QTY.
1	30011214	ALUMINUM BASE PADMOUNT – 25-50 kVA	1

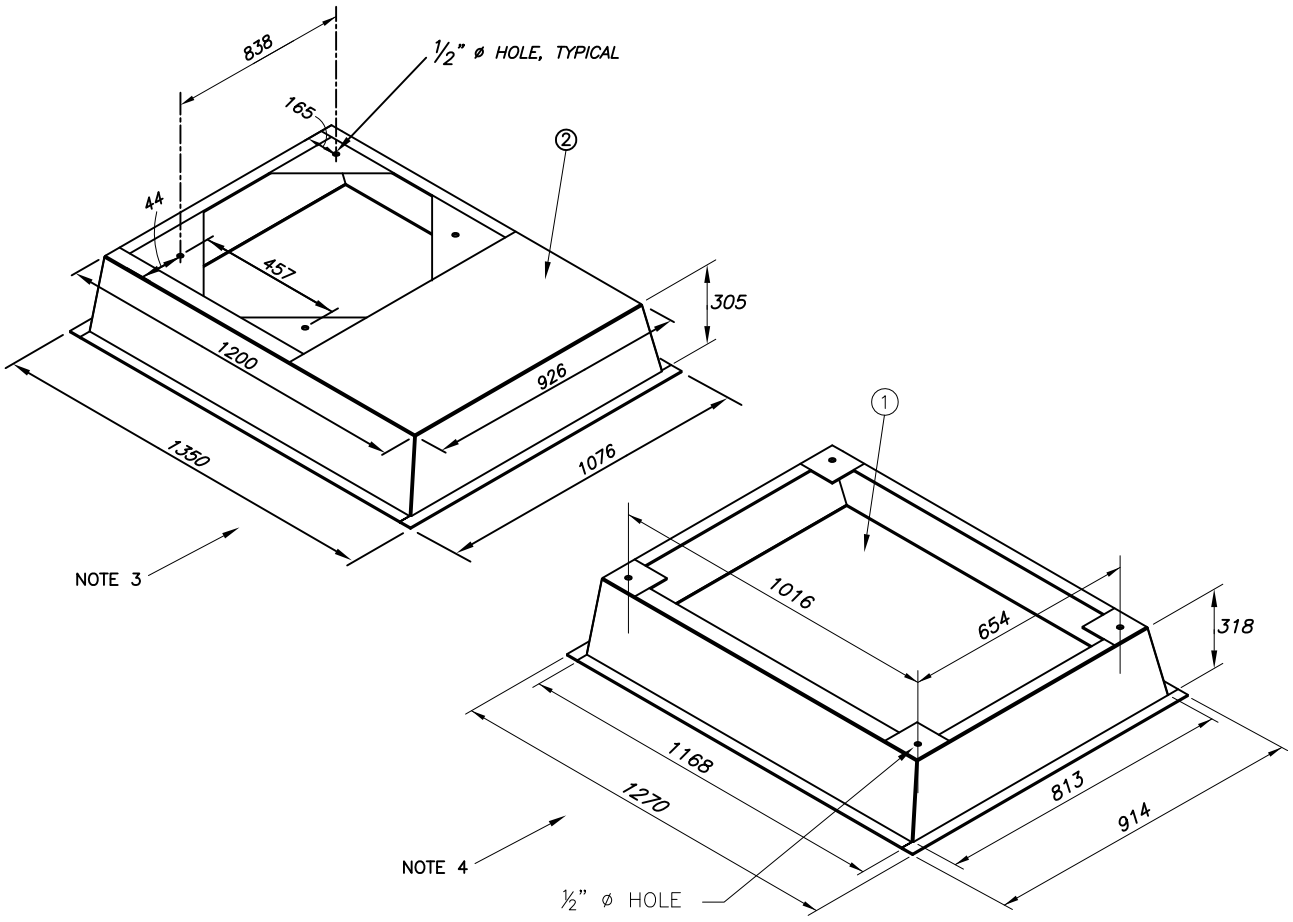
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
*	* *	* *	* *	
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	* *	

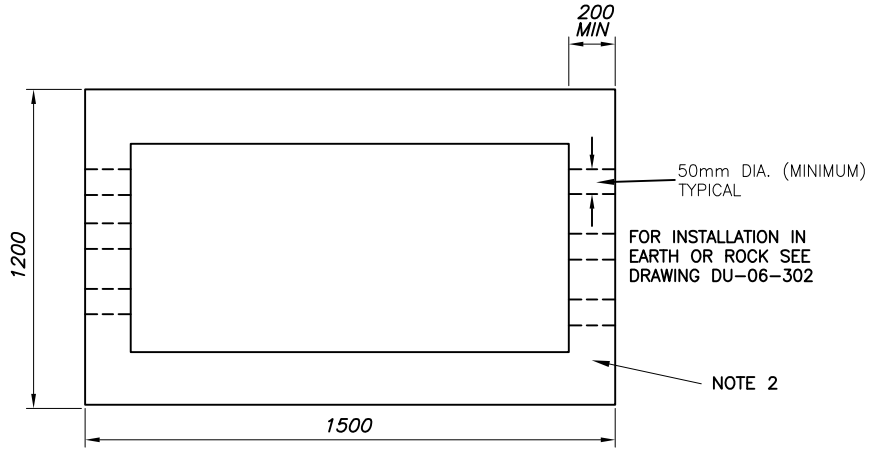
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	*

ALUMINUM BASE
1 PHASE LOW PROFILE CONVENTIONAL TRANSFORMER

Dwg. No. DU-06-304A Rev. 01





FIELD POURED CONCRETE LEVELLING PAD FOR 1 PHASE SWITCHING KIOSK

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
200	8"
305	1'–0"
318	1'–¾"
654	2'–2"
813	2'–8"
914	3'–0"
1118	3'–8"
1168	3'–10"
1076	3'–6"
1200	4'–0"
1270	4'–2"
1350	4'–5"
1474	4'–10"
1500	4'–11"

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. CONCRETE
3. ALUMINUM BASE FOR NEW CAMTRAM KISOK.
4. ALUMINUM BASE FOR KABAR KIOSK.

PART #	MM #	DESCRIPTION	QTY.
①	30011215	ALUMINUM BASE – 1 PHASE SWITCHING KIOSK	1
②	30011214	ALLUMINUM BASE PADMOUNT, 25–50KVA	1

Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	* *	* *	*	*		
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	*	*		

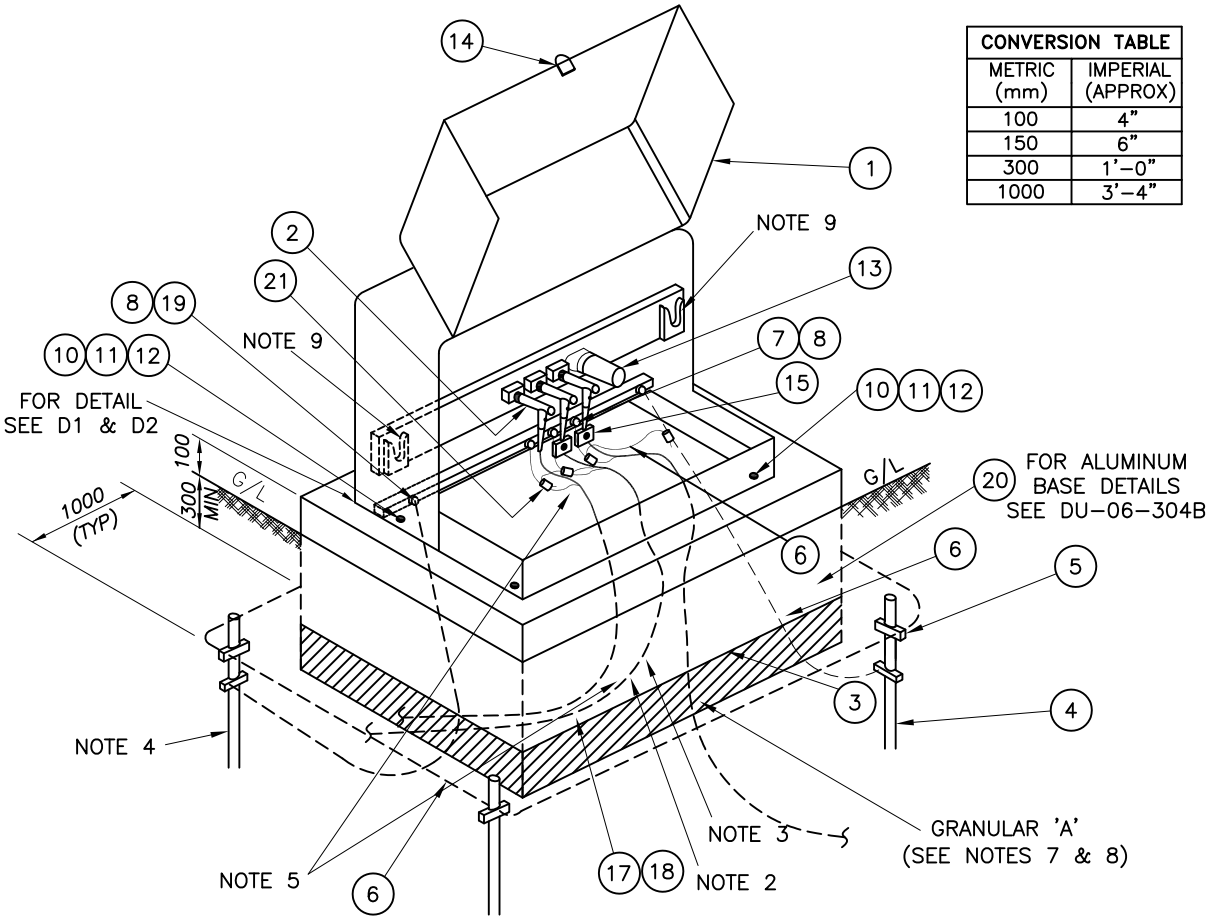
hydro one **Hydro One Networks Inc.**

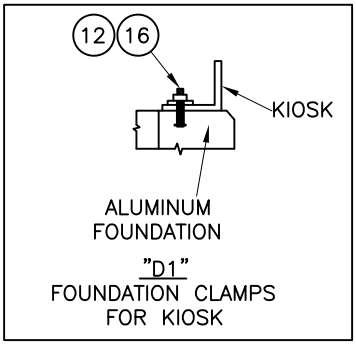
Drawn:	Approved:	Date:
A. VIDAD	*	NOV.15,2011

ALUMINUM BASE - SWITCHING KIOSK

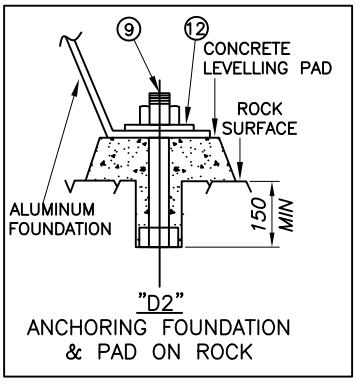
Dwg. No. DU-06-304B Rev. 01

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
150	6"
300	1'–0"
1000	3'–4"





"D1"
FOUNDATION CLAMPS FOR KIOSK



"D2"
ANCHORING FOUNDATION & PAD ON ROCK

PART #	MM #	DESCRIPTION	QTY.
①	–	KIOSK – 1 PHASE, WITH BUSHING INSERTS	1
②	–	ELBOW, LOADBREAK	AS REQD
③	–	CONCRETE LEVELLING PAD	1
④	30014142	ROD, GROUND, 3/4" X 10', GALV.	4
⑤	30006646	CONNECTOR, GRD WEDGE, GROUND ROD TO COPPER WIRE	6
⑥	30014480	BARE CONDUCTOR, COPPER #4, 7 STD, SD	AS REQD
⑦	30006431	CONNECTOR, TERMINAL, COMP PAD FOR C.N. WIRES (2/0 AL CABLE)	3 MIN
⑧	30001184	WASHER, ROUND, BRASS, 1/4" BOLT	5 MIN
⑨	–	BOLT, HEX HEAD GALV GR2, 1/2" DIA	AS REQD
⑩	30001353	BOLT, GALV, HEX 1/2" X 1–3/4" LG	4
⑪	30001591	WASHER, ROUND, STEEL, 1/2" BOLT	4
⑫	30001605	WASHER LOCK SPRING, STEEL, 1/2" BOLT	8
⑬	30007478	CAP INSULATING, 28 kV	1 MAX
⑭	30000346	PADLOCK	1
⑮	30013112	FAULT INDICATOR, MECHANICAL TYPE	2 MIN
⑯	30001312	BOLT, HEX HEAD GALV, 1/2" DIA, 1" LG	4
⑰	AS REQD	DUCT, PVC RIGID	AS REQD
⑱	AS REQD	DUCT, PVC BEND	AS REQD
⑲	30006864	CONNECTOR, TERM COMP PAD, FOR #4 AWG	2
⑳	30011215 30011214	ALUMINUM BASE – SWITCHING KIOSK	1
㉑	30006154	SPLIT BOLT, W6–2AWG, STRAND	AS REQD

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
3. PRIMARY CABLES ENTERING THE KIOSK BASE TO BE ENCASED SUITABLY IN PVC DUCT TO 100 mm ABOVE GRADE IN KIOSK BASE (THIS MAY REQUIRE CURVED DUCT).
4. FOR DETAILS OF GROUNDING SEE DU–06–303.
5. LEAVE SUFFICIENT SLACK THAT WILL ALLOW ANY LOADBREAK ELBOW TO BE MOVED TO A PARKING POSITION.
6. IF EARTH OVERBURDEN IS LESS THAN 300 mm DEEP, ANCHOR FOUNDATION AND LEVELING PAD ON ROCK SURFACE – SEE D2.
7. 150 mm THICK LAYER OF GRANULAR "A" (GRAVEL) BE PROVIDED UNDER CONCRETE/ALUMINUM FOUNDATION FOR LEVELLING AND STABILITY IF REQUIRED.
8. THE TOP OF THE BASE IS TO BE AT LEAST 100 mm ABOVE GRADE.
9. A SPARE CABLE MAY BE PLACED ON A FEED THROUGH IN THE PARKING STAND POSITION WITH THE SPARE INSERT COVERED BY AN INSULATING CAP.

REFERENCES:

SECTION 1	DEFINITIONS
SECTION 6C	CONSTRUCTION GUIDE
SECTION 3	SINGLE PHASE PRIM. SW.
SECTION 16	MATERIALS LIST

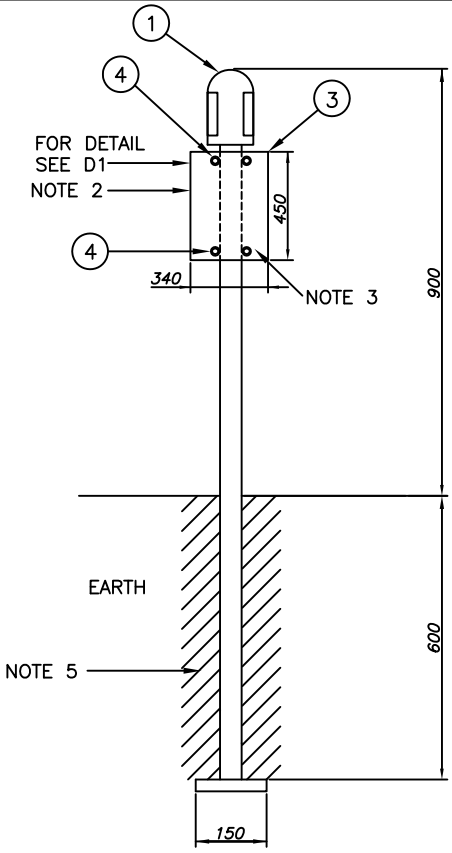
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
*	* *	* *	* / *	
02	NOV 2011	4 GROUND RODS & GROUNDING, MM#'S & PARTS ADDED	WB / PC	

hydro one **Hydro One Networks Inc.**

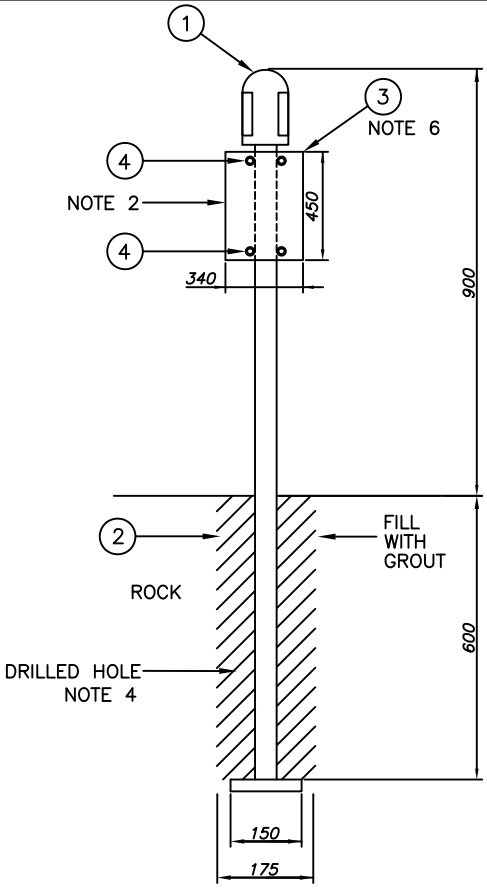
Drawn:	Approved:	Date:
W. BURDEN	*	NOV.15,2011

SINGLE - PHASE PAD - MOUNTED
KIOSK INSTALLATION - ALUMINUM BASE

Dwg. No. DU-06-305 Rev. 02



POST TYPE IN EARTH

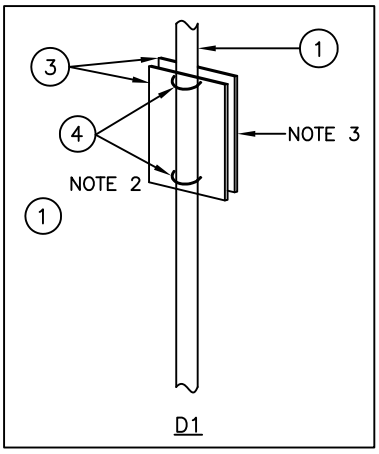


POST TYPE IN ROCK

PART #	MM #	DESCRIPTION	QTY.
①	10000425	UNDERGROUND MARKER – BURIED CABLE WARNING SIGN	1
②	30013957	GROUT FOR ROCK ANCHOR	1
③	–	WARNING SIGN PLATE (340 X 450) – "STAY CLEAR – HIGH VOLTAGE CABLE"	2
④	–	U BOLT 3/8" WITH WASHER & NUT	4

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. THE WARNING SIGN PLATES ARE TO BE FIELD INSTALLED. KEEP SIGN AS HIGH AS POSSIBLE FOR VISIBILITY.
3. INSTALL TWO PLATES BACK–TO–BACK.
4. DIAMETER OF DRILLED HOLE IN ROCK IS APPROXIMATELY 175 mm.
5. BACKFILL AND COMPACT THE SOIL AFTER INSTALLATION OF THE MARKER

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
150	6"
175	7"
203.2	8"
342.9	1'–1¾"
279.4	11"
458	1'–6"
600	2'–0"
900	3'–0"



D1

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 16 MATERIALS LIST

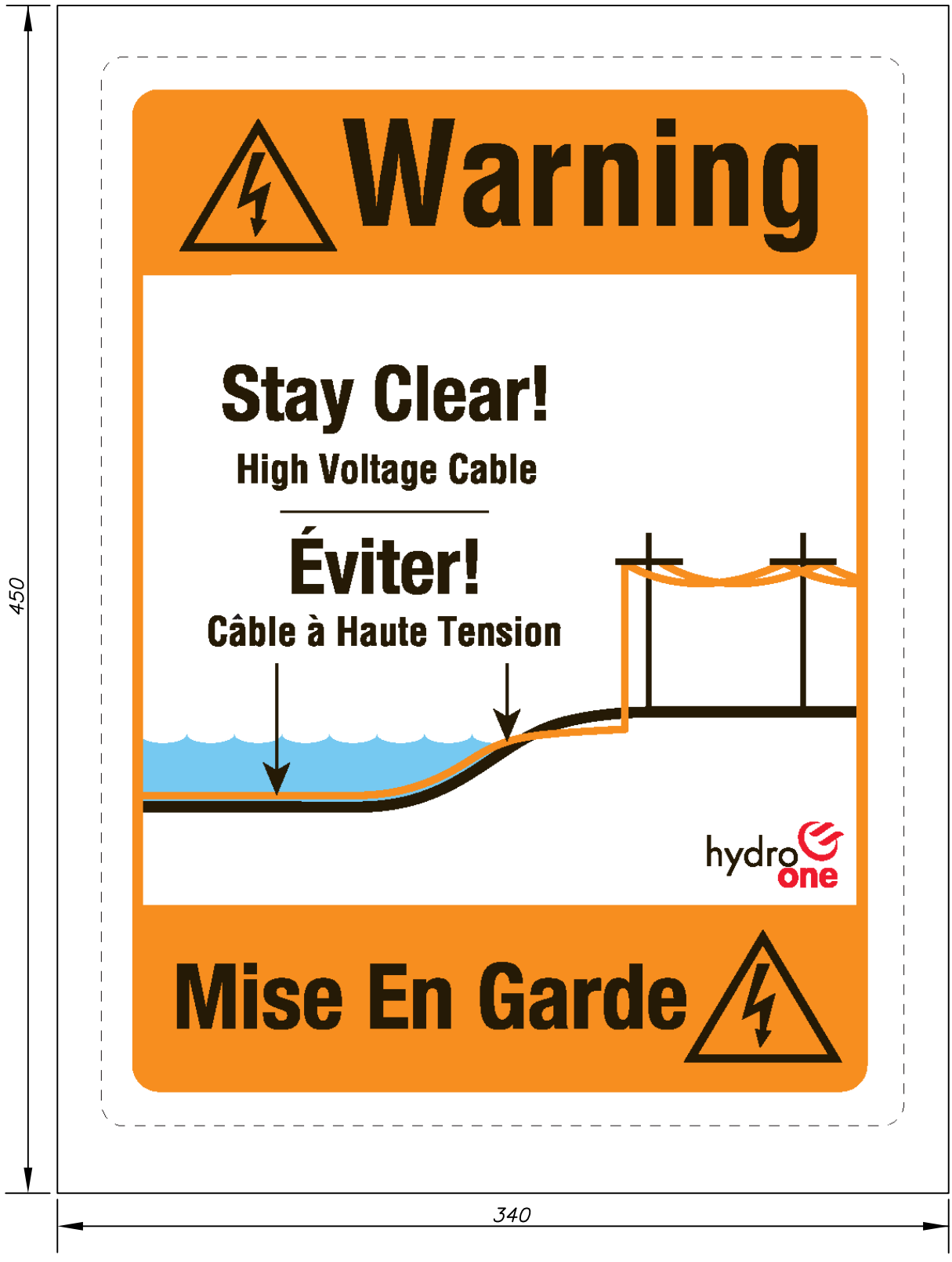
Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	* *	* *	*	*		
01	OCT 2011	REDRAWN WITH EDITORIAL CHANGES	*	*		

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	OCT.31,2011

SUBMARINE CABLE - WARNING SIGN INSTALLATION

Dwg. No. DU-06-401 Rev. 01



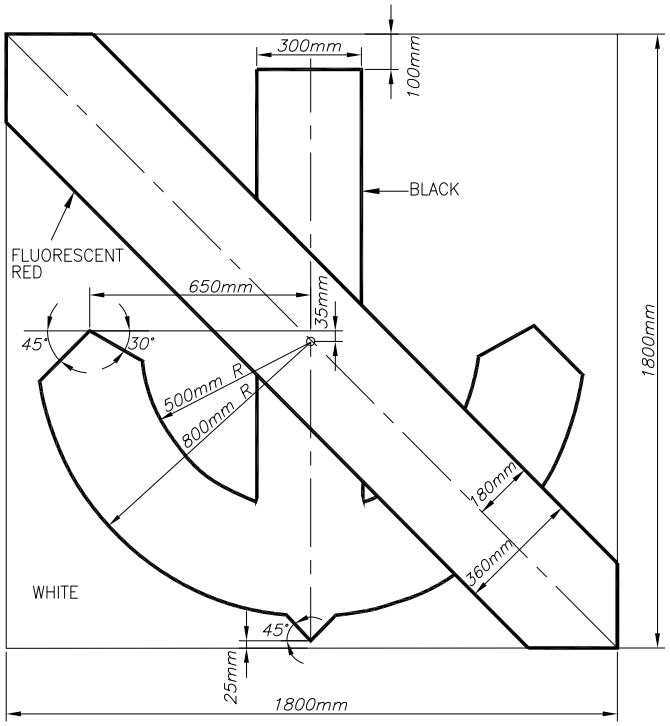
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
*	* *	* *	* / *	
01	* *	REDRAWN WITH EDITORIAL CHANGES	* / *	

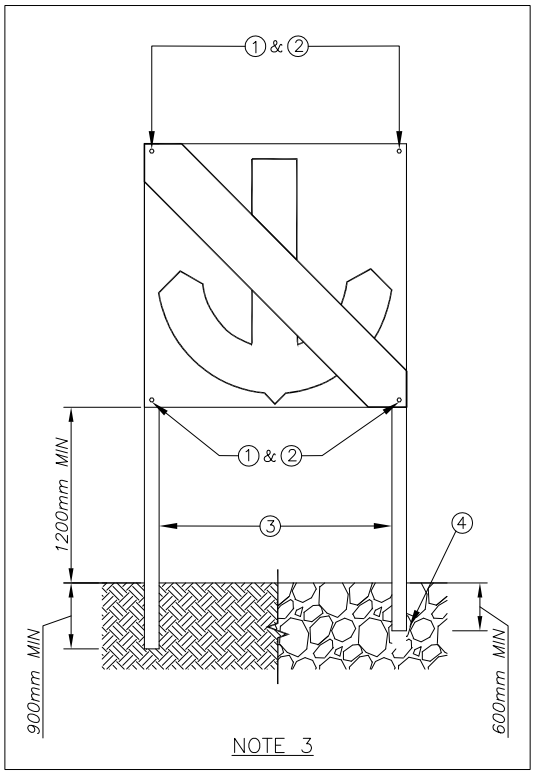
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	*

WARNING SIGN
STAY CLEAR - HIGH VOLTAGE CABLE

Dwg. No. DU-06-401A Rev. 01





PART #	MM #	DESCRIPTION	QTY.
①	30001143	BOLT, HEX HEAD, GALV, 5/8"	4 (MIN)
②	30001594	WASHER, SQUARE, GALV, 5/8"	4 (MIN)
③	–	4 X 4, PRESSURE TREATED POSTS	2 (MIN)
④	30013957	GROUT	AS REQD

DISTANCE SIGN TO BE SEEN	MULTIPLY LINEAR DIMENSIONS BY THE FACTOR INDICATED
185 m	0.70
463 m	0.85
926 m	1.00
1389 m	1.15
1852 m	1.30
2778 m	1.70

SIGN SCALING REFERENCE TABLE
(SEE NOTE 4)

NOTES:

1. THE DISTANCE FROM THE BOTTOM OF THE SIGN TO GROUND ELEVATION TO BE A MINIMUM OF 1.2 METRES.
2. SIGN TO BE INSTALLED IN A CLEARLY VISIBLE LOCATION ONE METRE ABOVE THE HIGH WATER LINE. THE SIGN SHALL BE A MINIMUM SIZE TO BE CLEARLY LEGIBLE FROM THE CENTRE OF THE SHIPPING CHANNEL AND SHALL BE MOUNTED EITHER ON SUBMARINE CABLE TERMINATION POLES OR OTHER SUITABLE PERMANENT SUPPORT (SEE SIGN SCALING REFERENCE TABLE).
3. SIGN SUPPORT DESIGN: NEED A MINIMUM OF TWO 4 X 4 PRESSURE TREATED POSTS SET AT LEAST 900 mm IN EARTH OR 600 mm IN ROCK. SIGN TO BE ATTACHED TO THE PRESSURE TREATED POSTS BY 5/8" X 6" GALVANIZED HEXAGONAL BOLT, NUT AND WASHERS.
4. EXAMPLE: FOR 500m CROSSING, IE. THE DISTANCE FROM THE CENTER OF CHANNEL TO SIGN OF 250m MAX USE SIGN SCALING REFERENCE TABLE NEXT HIGHEST REFERENCE "DISTANCE TO BE SEEN" VALUE. (463m = FACTOR OF 0.85).

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 16 MATERIALS LIST

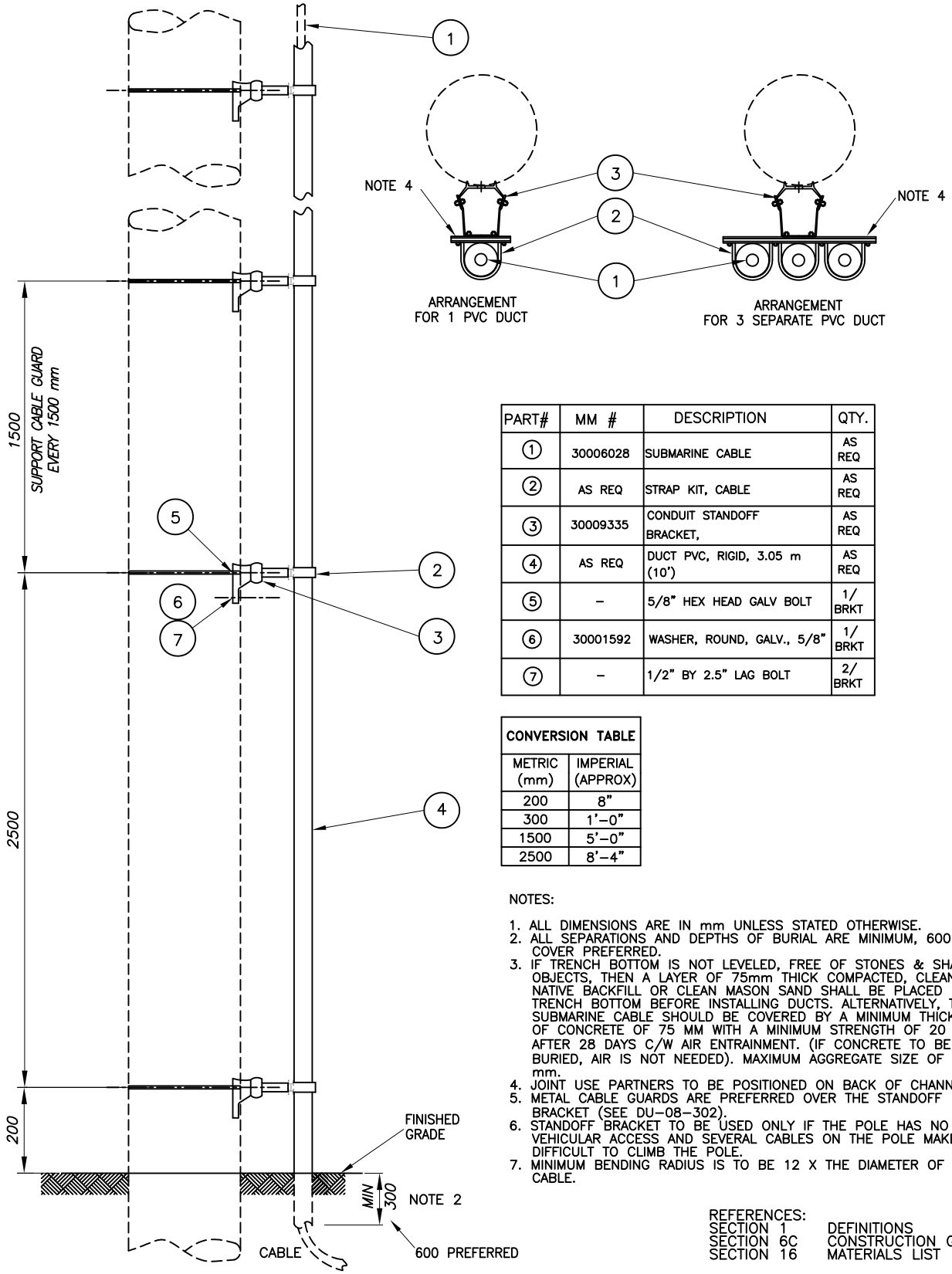
Rev. No.	Issue Date	Revision	Dwn	Approved By	Date
*	* *	* *	*	*	
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	*	*	

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	*

SUBMARINE CABLE CROSSING
- STANDARD "NO ANCHOR" SIGN

Dwg. No. DU-06-402 Rev. 01



PART#	MM #	DESCRIPTION	QTY.
①	30006028	SUBMARINE CABLE	AS REQ
②	AS REQ	STRAP KIT, CABLE	AS REQ
③	30009335	CONDUIT STANDOFF BRACKET,	AS REQ
④	AS REQ	DUCT PVC, RIGID, 3.05 m (10')	AS REQ
⑤	–	5/8" HEX HEAD GALV BOLT	1/ BRKT
⑥	30001592	WASHER, ROUND, GALV., 5/8"	1/ BRKT
⑦	–	1/2" BY 2.5" LAG BOLT	2/ BRKT

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
200	8"
300	1'–0"
1500	5'–0"
2500	8'–4"

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. ALL SEPARATIONS AND DEPTHS OF BURIAL ARE MINIMUM, 600 mm COVER PREFERRED.
3. IF TRENCH BOTTOM IS NOT LEVELED, FREE OF STONES & SHARP OBJECTS, THEN A LAYER OF 75mm THICK COMPACTED, CLEAN NATIVE BACKFILL OR CLEAN MASON SAND SHALL BE PLACED IN THE TRENCH BOTTOM BEFORE INSTALLING DUCTS. ALTERNATIVELY, THE SUBMARINE CABLE SHOULD BE COVERED BY A MINIMUM THICKNESS OF CONCRETE OF 75 MM WITH A MINIMUM STRENGTH OF 20 MPA AFTER 28 DAYS C/W AIR ENTRAINMENT. (IF CONCRETE TO BE BURIED, AIR IS NOT NEEDED). MAXIMUM AGGREGATE SIZE OF 20 mm.
4. JOINT USE PARTNERS TO BE POSITIONED ON BACK OF CHANNEL
5. METAL CABLE GUARDS ARE PREFERRED OVER THE STANDOFF BRACKET (SEE DU–08–302).
6. STANDOFF BRACKET TO BE USED ONLY IF THE POLE HAS NO VEHICULAR ACCESS AND SEVERAL CABLES ON THE POLE MAKES IT DIFFICULT TO CLIMB THE POLE.
7. MINIMUM BENDING RADIUS IS TO BE 12 X THE DIAMETER OF THE CABLE.

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 16 MATERIALS LIST

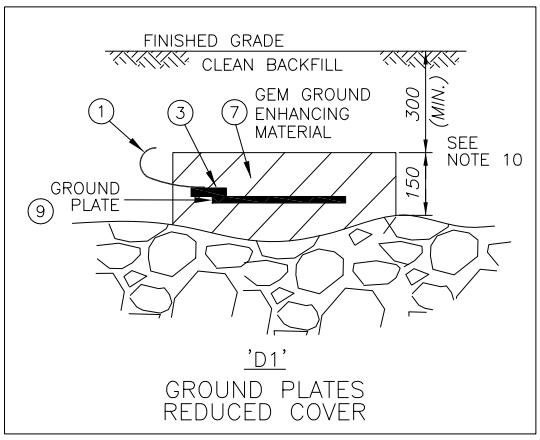
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
*	* *	* *	* *	
01	MAY 2010	REDRAWN WITH EDITORIAL CHANGES	* *	

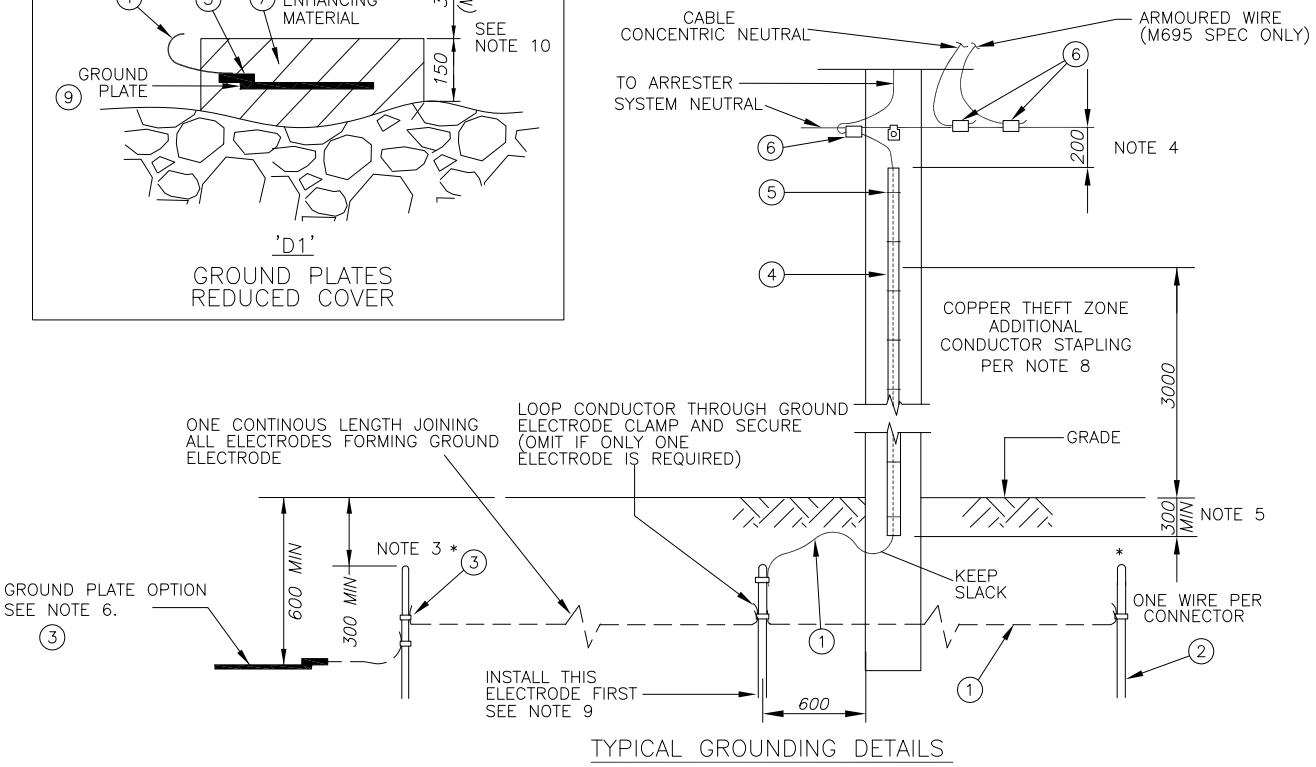
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	*

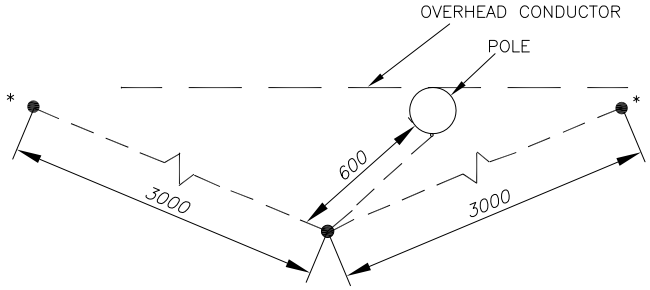
SUBMARINE CABLE STANDOFF BRACKET - WOOD POLES

Dwg. No. DU-06-403 Rev. 01





TYPICAL GROUNDING DETAILS



CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
200	8"
300	1'–0"
600	2'–0"
3000	10'–0"

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 16 MATERIALS LIST

PART #	MM #	DESCRIPTION	QTY.
1	30014480	BARE COND, COPPER, 4AWG	
2	30014142	ROD, GROUND, 3/4" x 10ft, GALVANIZED	1(MIN)
3	30006646	CONNECTOR, GROUND ROD	1(MIN)
4	30000053	MOULDING, GROUND WIRE	AS REQD
5	30001753	STAPLE 3", MOULDING	AS REQD
6	AS REQD	CONNECTOR, TAP WEDGE	AS REQD
7	30025402	GEM. MATERIAL	AS REQD
8	30013881	STAPLE, GROUND WIRE	NOTE 8
9	30025401	GRD. PLATE, GALVANIZED	AS REQD

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. DO NOT INSTALL THE GROUND ELECTRODE CONNECTOR ON THE TAPERED SECTION OF THE GROUND ELECTRODE.
3. ADDITIONAL GROUNDING (*) IF MAIN GROUND RESISTANCE > 25 ohms. ADDITIONAL NUMBER OF ELECTRODES DOES NOT EXCEED TWO.
4. ON JOINT USE POLES, THE WIRE GUARD SHALL EXTEND TO AT LEAST 1.0 m ABOVE COMMUNICATION PLANT OR 200 mm BELOW NEUTRAL, WHICHEVER IS HIGHER.
5. INCREASE DEPTH TO 500 mm IN CULTIVATED LAND.
6. GROUND PLATES TO BE INSTALLED ONLY IF GROUND RODS CANNOT BE DRIVEN DUE TO ROCKY GROUND.
7. FOR ADDITIONAL DETAILS REFER TO OVERHEAD DISTRIBUTION STANDARDS–SECTION 12
8. STAPLE CONDUCTOR EVERY 15cm TO 3M ABOVE GRADE BEFORE INSTALLING THE WOOD MOULDING. 50cm TYP. ELSEWHERE.
9. IN ROCKY/POOR SOIL CONDITIONS THE FIRST ELECTRODE MAY BE INSTALLED BENEATH THE POLE PER DL12–302.
10. MECHANICAL PROTECTION (75mm 21 MPa CONCRETE) IS REQUIRED OVER PLATES AND GROUND WIRES FOR BURIAL DEPTHS LESS THAN 300mm.

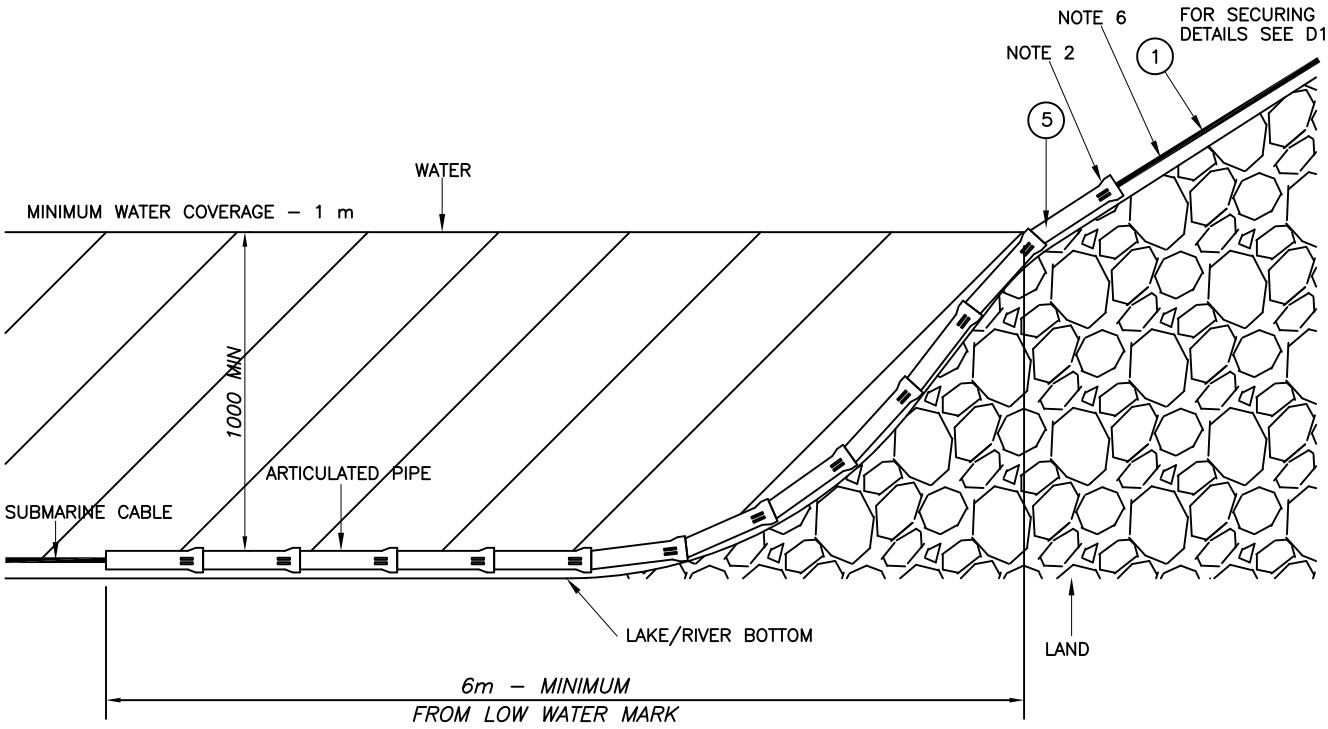
Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	* *	* *	*	*		
02	OCT 2011	DELETED METAL GUARD ADDED PLATE OPTION	*	*		

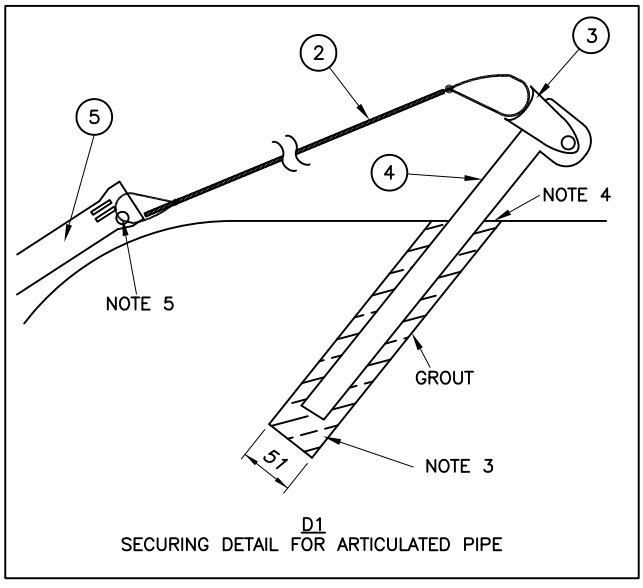
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
P.CIARMOLI	*	OCT.14,2011

GROUNDING DETAILS AT PRIMARY AND SUB - TRANSMISSION RISER/DIP POLE

Dwg. No. DU-06-404 Rev. 02





D1
SECURING DETAIL FOR ARTICULATED PIPE

PART #	MM #	DESCRIPTION	QTY.
1	30002885	9 mm GUY WIRE	AS REQ
2	30007333 30000774	GRIP, GUY WIRE 9 m GRIP, GUY WIRE 9 m	2
3	30007338	ADAPTER, DEAD END	AS REQ
4	30000755	ANCHOR, ROCK, WEDGE 18"	1
5	–	ARTICULATED DUCTILE IRON PIPE	AS REQ

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE
2. INSTALL ARTICULATED PIPE TO 1 m ABOVE HIGH WATER MARK.
3. ANCHOR EMBEDMENT TO BE MINIMUM 14".
4. HOLE WIDTH TO BE 51 mm
5. SECURE "EYE" OF ARTICULATED PIPE TO GUY WIRE
6. CABLE, IF EXPOSED, TO BE COVERED WITH CONCRETE OR DIRECTLY BURIED BEYOND THE PIPE END.

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
51	2"
356	1'–2"
1000	3'–4"

REFERENCES:

SECTION 1	DEFINITIONS
SECTION 5	O/H DIST. STANDARD
SECTION 6C	CONSTRUCTION GUIDE
SECTION 16	MATERIALS LIST

Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	MAY 2010	* *	*	*		
01	* *	REDRAWN WITH EDITORIAL CHANGES	*	*		

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	*

SHORELINE PROTECTION OF CABLES WITH ARTICULATED PIPE

Dwg. No. DU-06-405 Rev. 01

SUB-SECTION 6C (b)
THREE PHASE DISTRIBUTION
UP TO 27.6kV
SUBMARINE INSTALLATIONS

Sub-Section 6C (b)
Three-Phase Distribution up to 27.6 kV

In This Section

This section details the various construction related requirements for the installation of three-phase submarine distribution systems up to 16/27.6 kV.

This Section is divided into Sub-sections as follows:

Sub-Section 6C (b) – 1
General

Scope

This section applies to the installation of standard, three-phase submarine distribution systems operating at three-phase primary voltages up to 16/27.6 kV that:

- typically serve customers on islands or along the shorelines of lakes
- are owned by Hydro One Networks Inc. (Hydro One)

Purpose

The purpose of this section is to provide direction and support to constructors for the installation of submarine cable systems and to inspectors for inspection of constructed facilities.

This construction guide is prepared to ensure that:

- the submarine distribution systems owned by Hydro One are constructed on a consistent basis to provide for safe and reliable operation, and
- only use materials approved by Hydro One for the construction of such submarine distribution systems.

General Rules

Submarine distribution systems owned by Hydro One shall be constructed in accordance with the Hydro One approved design and layout drawings and shall comply with these standards. Any proposed deviation from these standards shall be submitted to and approved by Hydro One Technical Services prior to construction.

All customer-owned equipment shall comply with the Ontario Electrical Safety Code.

Safety

All construction shall be carried out with adequate safeguards to minimize the risk to the public, the workers, and existing structures. All applicable construction safety requirements of Hydro One, OH&SA, Ministry of Natural Resources, local Municipalities and other regulators shall be followed.

As Built Drawings

Upon completion of construction, signed and red-lined “as-built” drawings shall be submitted to Hydro One.

Sub-Section 6C (b) – 2
Cable Installation – Primary and Secondary

General

Construction standards for three-phase cable installation shall be consistent with the construction standard for single phase cable installation as detailed in Sub-Section 6C (a) -2.

Primary Cable

A three-phase primary cable installation shall consist of three individual single-conductor cables.

The primary cable shall be in accordance with Hydro One Standard Specifications M-355 and M-695.

The standard M-355 cable system is single conductor, submarine cable with aluminum or copper core, individually jacketed copper-clad steel wire concentric neutral/armour and cross-linked polyethylene (TRXLPE) insulation. The cables of voltage classes 15 kV and 28 kV (phase-phase) are for operation on grounded neutral systems up to 8.0/13.8 kV and 16.0/27.6 kV respectively.

The standard M-695 cable system is single conductor, submarine cable with copper core, cross-linked polyethylene (TRXLPE) insulation, copper concentric neutral, polyethylene jacket, individually jacketed steel wire armour and jute or hessian cover. The cables of voltage classes 28 kV and 46 kV (phase-phase) are for operation on grounded neutral systems up to and including 16.0/27.6 kV, and 3 wire sub-transmission systems up to and including 44 kV, respectively.

Minimum Bending Radius

The bending radius for most common sizes of M-695 cable in submarine distribution are given in Table 2:

Table 2
Bending Radius of M-695 Cable
mm [Inch]

Conductor Size kcmil	M-695 Cable with tinned copper concentric neutral wire and individually jacketed steel wire armour
2/0 (28 kV)	559 [22]
350 (28 kV)	687 [27]
500 (28 kV)	723 [29]
750 (28 kV)	828 [33]

Note: For the bending radius of the other sizes refer to the manufacturer data on outer diameter of the cable.

Sub-Section 6C (b) – 3
Overhead to Underground Transition

General

This section details the standards for installation of equipment on poles located on the mainland/island where the overhead circuit terminates on a pole and transitions to underground/submarine cables. This instruction is applicable for system voltages up to 16/27.6 kV.

Pole Limitations

The support of cables on poles for three-phase submarine installations will be limited to three cables (or four should a spare cable be required).

Stand-off Brackets

Stand-off brackets facilitate access to pole-mounted equipment by climbing. These can be used where vehicular access is not possible and there is more than one cable on the pole. Riser poles and/or dip poles may utilize stand-off bracket to support any combination of primary/secondary communication cables. The bracket has space on both sides which would allow distinct separation of primary cables from secondary and communication cables. Refer to Drawing DU-06-403.

Primary Cable Installation

Pole-mounted primary submarine cables shall be installed with cold shrink terminations. The cable and its termination shall be adequately supported on the dip pole as shown on drawings DU-06-201 and 202. The cable shall be protected by metallic guards from at least 600 mm below grade to the full length of cable run on the pole. The stand-off bracket referred to in the preceding clause will accommodate a cable guard if required. The cable bending radius shall not be less than 12 times the cable diameter. To allow for ground settlement, some slack shall be kept on the cable at the pole base.

When installing more than one circuit (each of three single conductor cables) on rock and subsequently covering with concrete, a minimum of 15 cm between circuits shall be maintained. Also, cables shall not cross over one another unless precautions are taken to avoid direct cable contact, e.g. a 10 cm layer of sand over the lower cable would be satisfactory. The Design Guide project drawings shall be followed for the proper spacing and cable arrangement. Note that reduction in spacing reduces the cable ampacity.

Grounding Conductors

Grounding conductors on poles shall be protected as a minimum with a wood guard for the length of the conductor up to the connection point to the neutral. If the riser pole is in close proximity to roadways, the wood guard should be further protected by a one piece metal guard buried to a depth of minimum 30 cm below grade extending up to 2.2 m above ground as shown in DU-06-404, or to be installed on the side of the pole that is not adjacent to the road.

Armour Shield

The armour of primary submarine cables on riser and dip poles shall be grounded at both ends of the cable section. The concentric neutral shall be connected to system neutral. Any deviation from this shall be approved by the Distribution Planner. Refer to DU-06-101 Sheet 1/2 for concentric neutral-cum-armour grounding of M-355 specification cable & DU-06-101 Sheet 2/2 for separate concentric neutral and armour grounding of M-695 specification cable.

Orientation of Attachments

The primary cable shall be oriented on the face of the stand-off bracket. Communication cables (if required) shall be positioned on the back surface of the stand-off bracket, between bracket and pole, and placed in such a way as not to impede the positioning of submarine cable.

Note: None of the attachments shall interfere with the use of lineman's climbers.

Cutout/Surge Arrester

For each cable (excluding the spare cable if provided), one fused cutout and metal oxide surge arrester shall be mounted on the dip pole using standard mounting hardware.

Fuse protection is required only at the source end but arrester protection is required at both ends of cable section.

Sub-Section 6C (b) – 4
Grounding

General

This section details the standards for installation of grounding systems that are adequate to protect against excessive ground potential rise during normal operating conditions, under fault conditions, and lightning surges.

The standard M-355 cable system is single conductor, submarine cable with aluminum or copper core, individually jacketed copper-clad steel wire concentric neutral/armour and cross-linked polyethylene (TRXLPE) insulation. The concentric neutral-cum-armour of this cable shall be grounded at both ends of the cable section.

The standard M-695 cable system is single conductor, submarine cable with copper core, cross-linked polyethylene (TRXLPE) insulation, copper concentric neutral, polyethylene jacket, individually jacketed steel wire armour and jute or hessian cover. The armour of this cable shall be grounded at both ends of the cable section. The Concentric neutral shall be connected to system neutral. Refer to Sub-Section 6D(c) -3 for system neutral grounding.

Grounding Conductor

Ground conductors used shall be bare copper, #4 AWG, 7 strands, or bare copper 1/0, 7 strands. The riser pole ground conductor shall be bare copper, #4 AWG, 7 strands for 4-wire distribution circuits. Equipment grounding conductors, if required, shall be bare copper, #4 AWG, 7 strands. The connections from armour wires and concentric neutral wires to the pole ground conductor, if required, shall be bare copper 1/0, 7 strands, as indicated in the drawings in Section 6C (b) -8.

Grounding Connections

All connections between grounding conductors and between grounding conductors to grounding plates/ground rods shall use approved connectors. Below ground connections shall use only the connectors that are approved for direct burial/concrete encasement application.

Grounding Rods, Grounding Plates

Grounding rods shall be the preferred alternative. Where use of ground rods is not feasible due to rocky conditions, ground plates are an acceptable alternative and these must be installed on undisturbed soil and used in conjunction with GEM (Ground Enhancement Material). A minimum of four (4) rods/plates per padmount transformer and switching kiosk, and one (1) rod/plate per pole shall be installed. Refer to Drawings DU-06-303, DU-06-305 and DU-06-404 for pole and/or equipment grounding details.

Ground Resistance

A minimum ground resistance of twenty-five (25) ohms shall be achieved at the pole location. Ground resistance may be measured by the 3-point method using a ground resistance tester and 2 remote electrodes, before the ground rod is connected. Alternatively a clamp-on ground resistance tester can be used after the connection to the ground wire and neutral has been made. As many as two (2) additional ground rods/plates should be installed to reduce the ground resistance if the minimum number of ground rods/plates cannot achieve a 25 ohm ground resistance.

Sub-Section 6C (b) – 5
Padmount Equipment

Padmount Transformer	The three-phase transformer shall be securely mounted to the transformer foundation.
Transformer Foundation, Kiosk, Vault	The foundation shall be mounted on a level surface of compacted gravel approximately 220 mm below grade or on a poured concrete foundation as per drawings. The top of the transformer foundation shall be approximately 100 mm above the finished grade.
Use of Helicopters	Refer to Sub-Section 6C (a) – 5

Sub-Section 6C (b) – 6
Documentation

As-Built Documentation

Submarine cable systems commonly operate for many years without requiring any repairs. When a component requires repair or replacement, it is important to have an accurate document that summarizes construction details.

The document should include:

i) plan and profile of where the cable was laid, both in the water and on land, including survey;
ii) control points and landmarks;
iii) location of obstructions;
iv) locations of splices;
v) complete Submarine Distribution System Mapping and drawings including GPS co-ordinates of splices;
vi) photographs.

Sub-Section 6C (b) – 7
Cleanup and Restoration

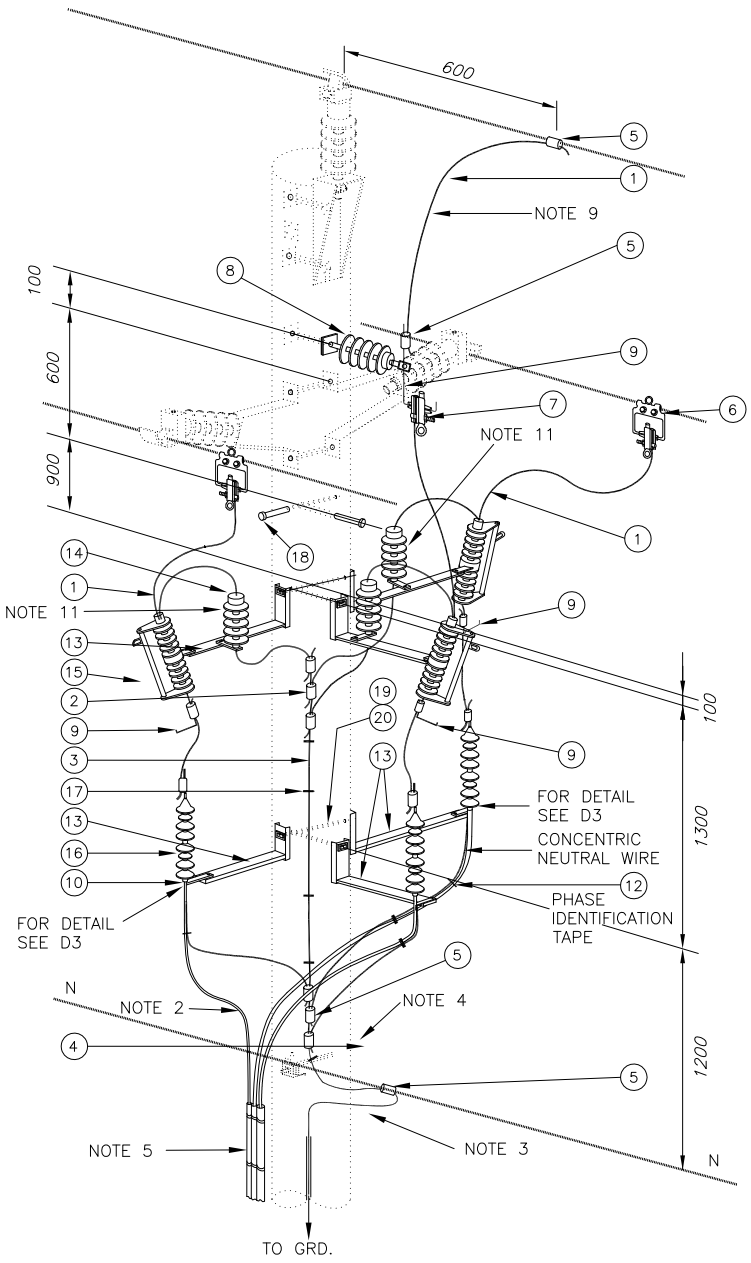
Cleanup and Restoration

Aquatic vegetation removed during the trenching operation should be contained and adequately disposed of on land. Vegetation allowed to drift downstream may adversely affect downstream users as the result of flow obstruction or choking of water intakes. Decaying vegetation may also cause odor and aesthetic problems.

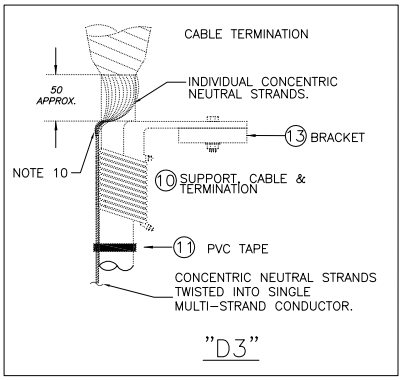
Sub-Section 6C (b) – 8
References and Drawings

In This Section This section contains the following drawings:

Description	Dwg. #	Rev.
Fused Primary Submarine Cable Termination – 3-phase	DU-06-201	R2
Un-fused Primary Submarine Cable Termination – 3-phase	DU-06-202	R2
Fused Primary Submarine Cable Termination – Spare Cable – 3-phase	DU-06-203	R2
Un-fused Primary Submarine Cable Termination – Spare Cable – 3-phase	DU-06-203A	R2



PART #	MM #	DESCRIPTION	QTY.
1	30005821 30005823 30005825	BARE COND, COPPER, 1/0 AWG, MHD SAME--2/0 SAME--4/0	AS REQD
2	30006509	CONNECTOR, TAP COMP, 6AWG – 4AWG	3
3	30014480	BARE COND, COPPER, 4AWG, 7 STRAND, SD	AS REQD
4	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
5	AS REQD	CONNECTOR, TAP WEDGE	AS REQD
6	AS REQD	CONNECTOR, STIRRUP, BOLTED	2
7	30007392	CONNECTOR, LIVE LINE	3
8	30008425	INSULATOR, STANDOFF 28 kV	1
9	30000770	CLAMP REST, INSULATOR TYPE	1
10	30008041	SUPPORT, CABLE & TERMINATION	3
11	30008331	TAPE, ELECTRICAL, PVC, BLACK	AS REQD
12	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	AS REQD
13	30000825	BRACKET, CUTOUT/ARRESTER	6
14	AS REQD	ARRESTER, RISER POLE	3
15	AS REQD	CUTOUT, FUSED	3
16	30007446	TERMINATION, COLD SHRINK, 28 kV, 1/0	3
17	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	AS REQD
18	30000777	CLAMP REST, POLE TYPE	3
19	AS REQD	BOLT, 3/4" DIA.	AS REQD
20	30001595	WASHER, SQUARE, 3/4" x 2" x 2"	AS REQD

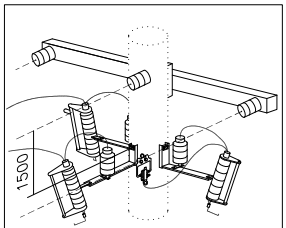


"D3"

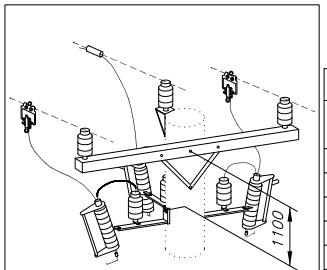
NOTES
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
3. SLACK LOOP OF GROUND WIRE.
4. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
5. THE PREFERRED INSTALLATION FOR CABLES ON A POLE IS COVERED BY METAL GUARDS AS PER DU-08-302. STANDOFF BRACKETS MAY BE USED WHERE AERIAL DEVICE ACCESS IS UNAVAILABLE. REFER TO DU-06-403.
6. FOLD BACK, BUNDLE TOGETHER, ATTACH TO CABLE BY TAPE, AND THEN CONNECT TO NEUTRAL.
7. FOR EXPOSED ENDS OF PE COVERED STEEL ARMOURED CABLE, ALWAYS SUSPEND CABLE POINTING DOWNWARDS TO STOP MOISTURE INGRESS. REMOVE PE COVER NEAR CONNECTOR.
8. FOR PRIMARY CABLES WITH SEPARATE CONCENTRIC NEUTRAL AND STEEL ARMOURED WIRES (M-695 SPEC CABLES), CONNECT BOTH ENDS OF THE ARMOUR SHEATH TO GROUND. REFER TO DRAWING DU-06-201 SHEET 2.
9. JUMPER AMPACITY SHOULD AT LEAST EQUAL CABLE AMPACITY.
10. ONE END OF THE PRIMARY SUBMARINE CABLE MUST HAVE FUSED PROTECTION.
11. REFER TO OVERHEAD DISTRIBUTION STANDARDS – SECTION 8 FOR CUTOUT AND ARRESTER SELECTION.

REFERENCES:

SECTION 1	DEFINITIONS
SECTION 6C	CONSTRUCTION GUIDE
SECTION 8	O/H – U/G TRANSITIONS
SECTION 16	MATERIALS LIST



"D2"
ARRANGEMENT ON 3-PH DEADEND FRAMINGS



"D1"
ARRANGEMENT ON 3-PH CROSSARM FRAMINGS

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
250	10"
600	2'-0"
900	3'-0"
1100	3'-7"
1200	4'-0"
1300	4'-4"
1500	5'-0"

Rev. No.	Issue Date	Revision	Dwn	Approved By
*	* *	* *	* / *	
02	NOV 2011	REDRAWN WITH EDITORIAL CHANGES & REDRAWN DETAIL D3	* / *	
			Chk	Date

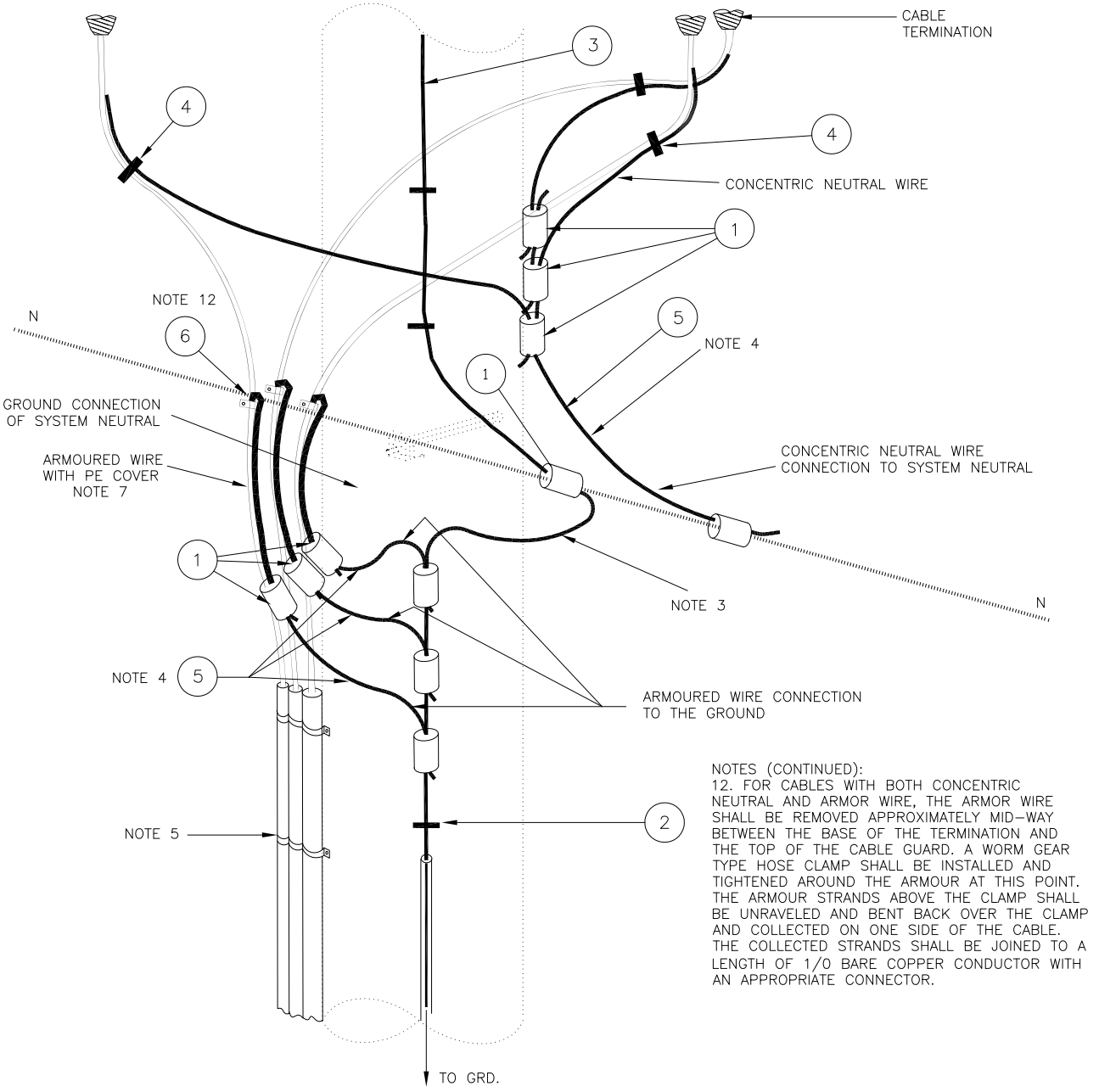
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

FUSED PRIMARY SUBMARINE CABLE TERMINATION
- 3 PHASE, 2.4/4.18 - 16/27.6 kV

Dwg. No. DU-06-201 SH. 1 OF 2 Rev. 02

PART #	MM #	DESCRIPTION	QTY.
1	AS REQD	CONNECTOR, TAP WEDGE	AS REQD
2	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	AS REQD
3	30014480	BARE COND, COPPER, 4AWG, 7 STRAND, SD	AS REQD
4	30008331	TAPE, ELECTRICAL, PVC, BLACK	AS REQD
5	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
6	30003502	CLAMP, GEAR TYPE	3



NOTES (CONTINUED):
12. FOR CABLES WITH BOTH CONCENTRIC NEUTRAL AND ARMOR WIRE, THE ARMOR WIRE SHALL BE REMOVED APPROXIMATELY MID-WAY BETWEEN THE BASE OF THE TERMINATION AND THE TOP OF THE CABLE GUARD. A WORM GEAR TYPE HOSE CLAMP SHALL BE INSTALLED AND TIGHTENED AROUND THE ARMOUR AT THIS POINT. THE ARMOUR STRANDS ABOVE THE CLAMP SHALL BE UNRAVELED AND BENT BACK OVER THE CLAMP AND COLLECTED ON ONE SIDE OF THE CABLE. THE COLLECTED STRANDS SHALL BE JOINED TO A LENGTH OF 1/0 BARE COPPER CONDUCTOR WITH AN APPROPRIATE CONNECTOR.

CONCENTRIC NEUTRAL AND ARMOURED CONNECTION FOR PRIMARY AND SUBTRANSMISSION CABLE – M-695 SPEC

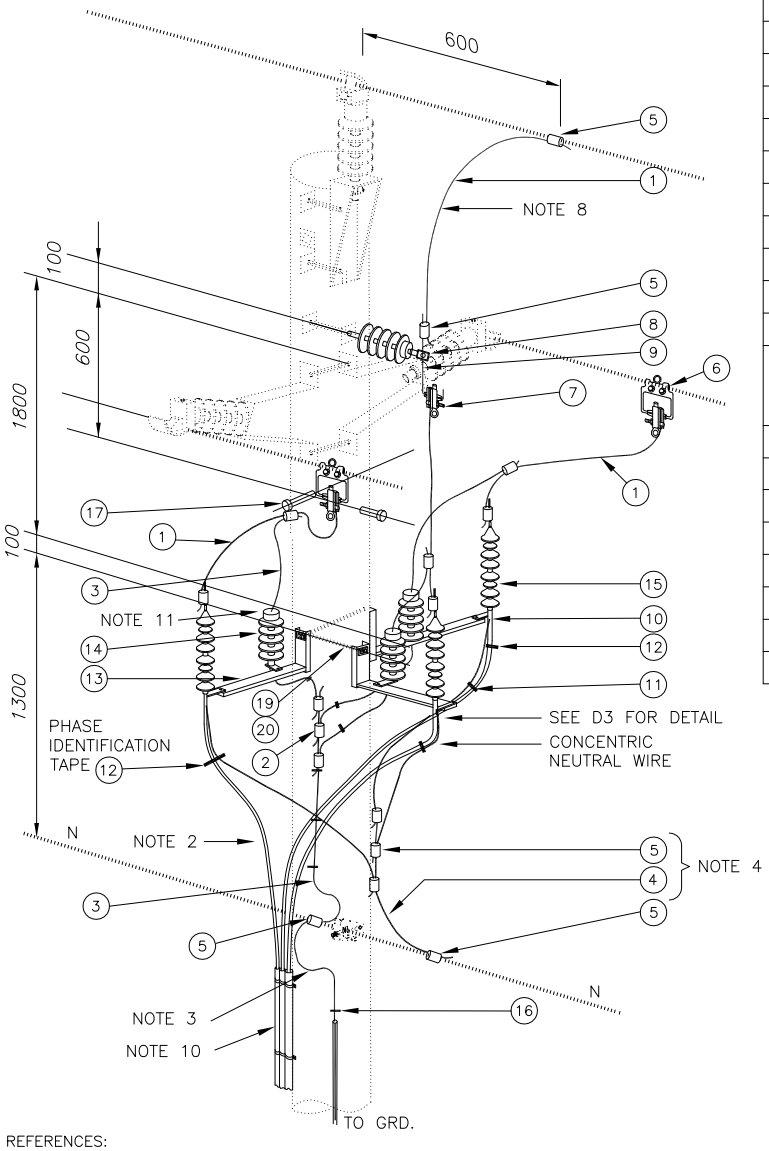
Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	* *	* *	*	*		
02	NOV 2011	* REDRAWN WITH EDITORIAL * CHANGES	*	*		

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

FUSED PRIMARY SUBMARINE CABLE TERMINATION
- 3 PHASE, 2.4/4.18 - 16/27.6 kV

Dwg. No. DU-06-201 SH. 2 OF 2 Rev. 02



PART #	MM #	DESCRIPTION	QTY.
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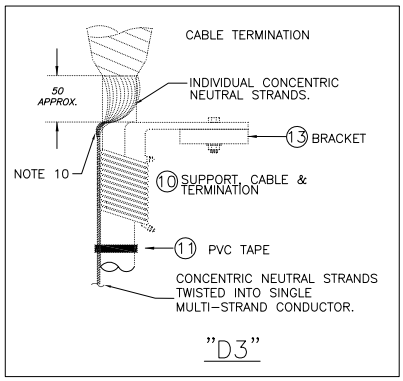
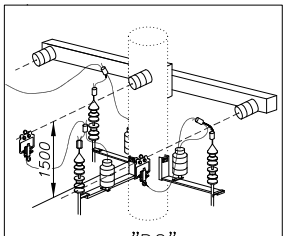
3	30014480	BARE COND, COPPER, 4AWG, 7 STRAND, SD	AS REQD
4	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
5	AS REQD	CONNECTOR, TAP WEDGE, AMP	AS REQD
6	AS REQD	CONNECTOR, STIRRUP, BOLTED	2
7	30007392	CONNECTOR, LIVE LINE	3
8	30008425	INSULATOR, STANDOFF 28 kV	1
9	30000770	CLAMP REST, INSULATOR TYPE	1
10	30008041	SUPPORT, CABLE & TERMINATION	3
11	30008331	TAPE, ELECTRICAL, PVC, BLACK	AS REQD
12	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	AS REQD
13	30000825	BRACKET, CUTOUT/ARRESTER	3
14	AS REQD	ARRESTER, RISER POLE	3
15	30007446	TERMINATION, COLD SHRINK, 28 kV, 1/0	3
16	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	AS REQD
17	30000777	CLAMP REST, POLE TYPE	3
18	30003502	CLAMP, GEAR TYPE	3
19	AS REQD	BOLT, 3/4" DIA.	AS REQD
20	30001595	WASHER, SQUARE, 3/4" x 2" x 2"	AS REQD

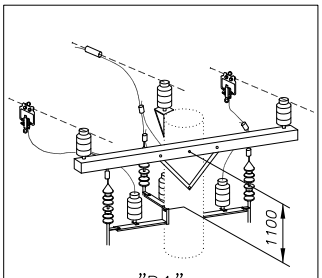


"D3"

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 8 O/H – U/G TRANSITIONS
SECTION 16 MATERIALS LIST



"D2"
ARRANGEMENT ON 3-PH DEADEND FRAMINGS



"D1"
ARRANGEMENT ON 3-PH CROSSARM FRAMINGS

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
250	10"
600	2'-0"
1100	3'-7"
1500	5'-0"
1800	6'-0"

NOTES
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
3. SLACK LOOP OF GROUND WIRE.
4. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
5. FOR PRIMARY CABLES WITH SEPARATE CONCENTRIC NEUTRAL AND STEEL ARMOURED WIRES (M-695 SPEC CABLES), CONNECT BOTH ENDS OF THE ARMOUR SHEATH TO GROUND. REFER TO DRAWING DU-06-202 SHEET 2.
6. FOLD BACK, BUNDLE TOGETHER, ATTACH TO CABLE BY TAPE, AND THEN CONNECT TO NEUTRAL.
7. FOR EXPOSED ENDS OF PE COVERED STEEL ARMOURED CABLE, ALWAYS SUSPEND CABLE POINTING DOWNWARDS TO STOP MOISTURE INGRESS. REMOVE PE COVER NEAR CONNECTOR.
8. JUMPER AMPACITY SHOULD AT LEAST EQUAL CABLE AMPACITY.
9. OTHER END OF THE PRIMARY SUBMARINE CABLE MUST HAVE FUSED PROTECTION.
10. THE PREFERRED INSTALLATION FOR CABLES ON A POLE IS COVERED BY METAL GUARDS AS PER DU-08-302. STANDOFF BRACKETS MAY BE USED WHERE AERIAL DEVICE ACCESS IS UNAVAILABLE. REFER TO DU-06-403.
11. REFER TO OVERHEAD DISTRIBUTION STANDARDS – SECTION 8 FOR CUTOUT AND ARRESTER SELECTION.

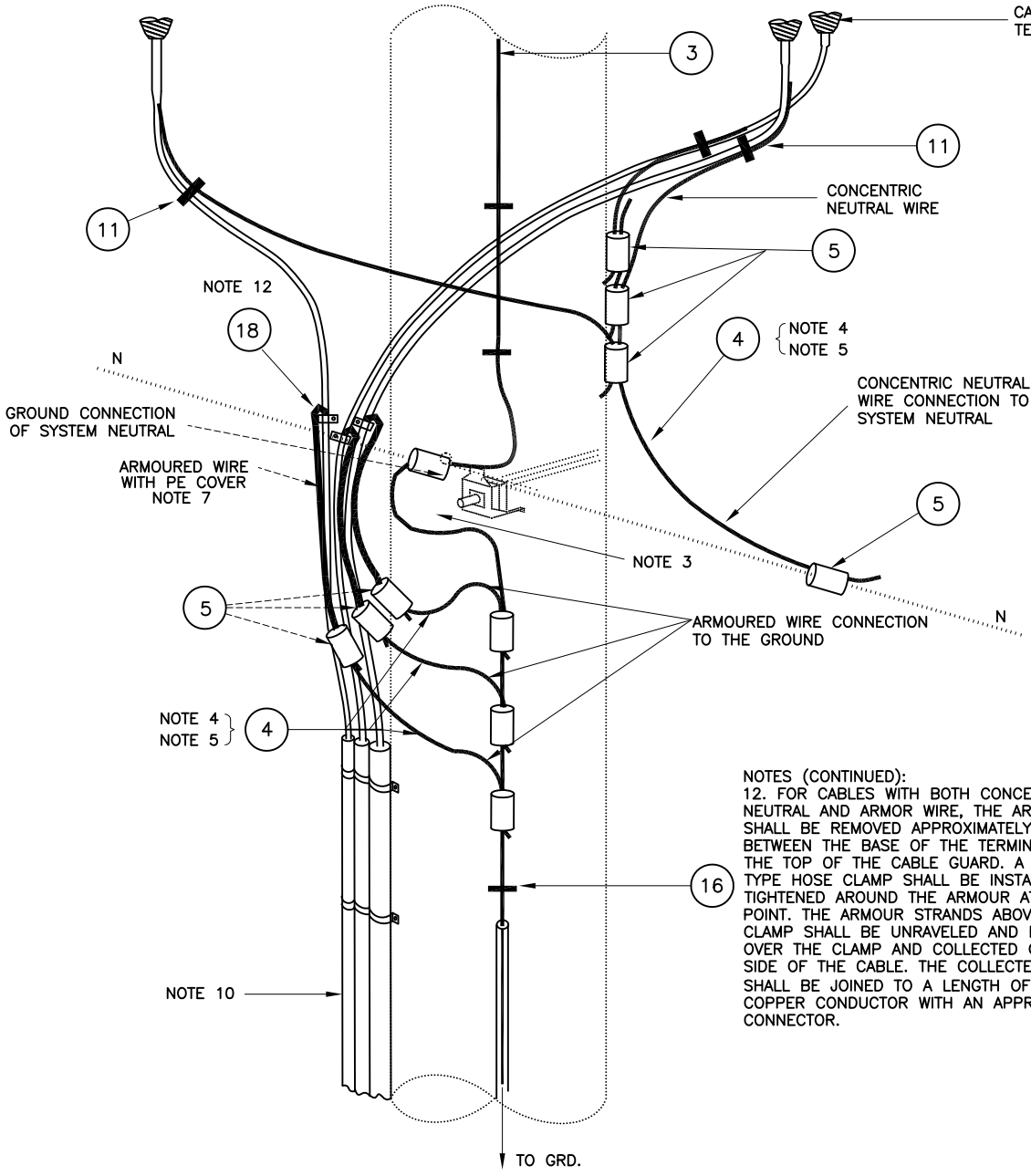
Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	* *	* *	*	*		
02	NOV 2011	REDRAWN WITH EDITORIAL CHANGES & REDRAWN DETAIL D3	*	*		

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

UNFUSED PRIMARY SUBMARINE CABLE TERMINATION
-3 PHASE, 2.4/4.18 - 16/27.6 kV

Dwg. No. DU-06-202 SH. 1 OF 2 Rev. 02



NOTES (CONTINUED):
12. FOR CABLES WITH BOTH CONCENTRIC NEUTRAL AND ARMOR WIRE, THE ARMOR WIRE SHALL BE REMOVED APPROXIMATELY MID-WAY BETWEEN THE BASE OF THE TERMINATION AND THE TOP OF THE CABLE GUARD. A WORM GEAR TYPE HOSE CLAMP SHALL BE INSTALLED AND TIGHTENED AROUND THE ARMOUR AT THIS POINT. THE ARMOUR STRANDS ABOVE THE CLAMP SHALL BE UNRAVELED AND BENT BACK OVER THE CLAMP AND COLLECTED ON ONE SIDE OF THE CABLE. THE COLLECTED STRANDS SHALL BE JOINED TO A LENGTH OF 1/0 BARE COPPER CONDUCTOR WITH AN APPROPRIATE CONNECTOR.

CONCENTRIC NEUTRAL AND ARMOURED CONNECTION FOR PRIMARY AND SUBTRANSMISSION CABLE – M-695 SPEC

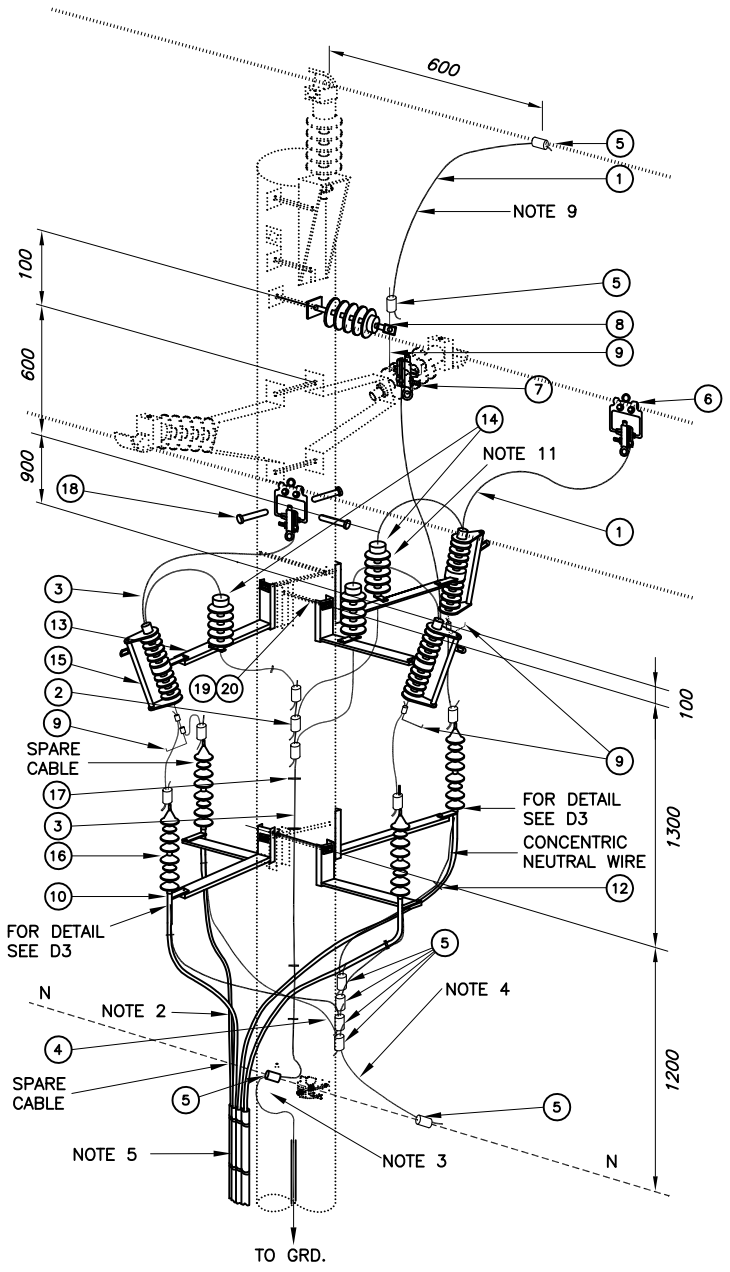
Rev. No.	Issue Date	Revision	Dwn	Approved By / Date
*	* *	* *	*	
02	NOV 2011	REDRAWN WITH EDITORIAL CHANGES	*	*

hydro one **Hydro One Networks Inc.**

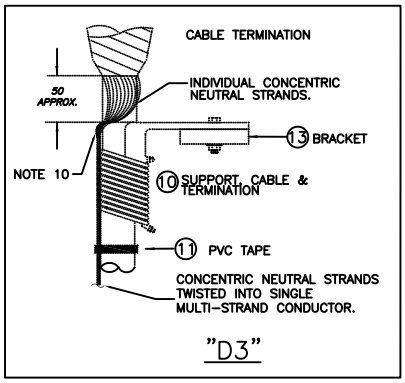
Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

UNFUSED PRIMARY SUBMARINE CABLE TERMINATION
-3 PHASE, 2.4/4.18 - 16/27.6 kV

Dwg. No. DU-06-202 SH. 2 OF 2 Rev. 02



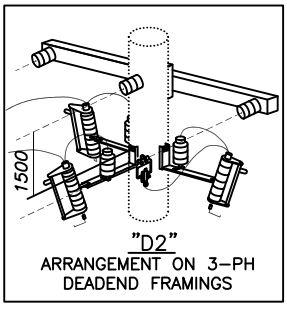
PART #	MM #	DESCRIPTION	QTY.
①	30005821 30005823 30005825	BARE COND, COPPER, 1/0 AWG, MHD SAME--2/0 SAME--4/0	AS REQD
②	30006509	CONNECTOR, TAP COMP, 6AWG – 4AWG	3
③	30014480	BARE COND, COPPER, 4AWG, 7 STRAND, SD	AS REQD
④	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
⑤	AS REQD	CONNECTOR, TAP WEDGE	AS REQD
⑥	AS REQD	CONNECTOR, STIRRUP, BOLTED	2
⑦	30007392	CONNECTOR, LIVE LINE	3
⑧	30008425	INSULATOR, STANDOFF 28 kV	1
⑨	30000770	CLAMP REST, INSULATOR TYPE	1
⑩	30008041	SUPPORT, CABLE & TERMINATION	4
⑪	30008331	TAPE, ELECTRICAL, PVC, BLACK	AS REQD
⑫	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	AS REQD
⑬	30000825	BRACKET, CUTOUT/ARRESTER	7
⑭	AS REQD	ARRESTER, RISER POLE	3
⑮	AS REQD	CUTOUT, FUSED	3
⑯	30007446	TERMINATION, COLD SHRINK, 28 kV, 1/0	4
⑰	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	AS REQD
⑱	30000777	CLAMP REST, POLE TYPE	3
⑲	AS REQD	BOLT, 3/4" DIA.	AS REQD
⑳	30001595	WASHER, SQUARE, 3/4" x 2" x 2"	AS REQD

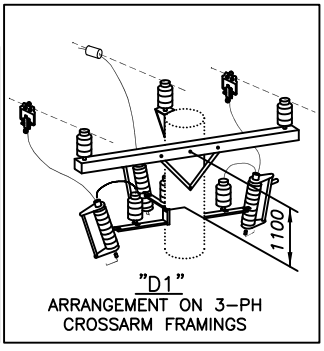


NOTES
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
3. SLACK LOOP OF GROUND WIRE.
4. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
5. THE PREFERRED INSTALLATION FOR CABLES ON A POLE IS COVERED BY METAL GUARDS AS PER DU-08-302. STANDOFF BRACKETS MAY BE USED WHERE AERIAL DEVICE ACCESS IS UNAVAILABLE. REFER TO DU-06-403.
6. FOLD BACK, BUNDLE TOGETHER, ATTACH TO CABLE BY TAPE, AND THEN CONNECT TO NEUTRAL.
7. FOR EXPOSED ENDS OF PE COVERED STEEL ARMOURED (M-695) CABLE, ALWAYS SUSPEND CABLE POINTING DOWNWARDS TO STOP MOISTURE INGRESS.
8. FOR PRIMARY AND SUBTRANSMISSION CABLES WITH SEPARATE CONCENTRIC NEUTRAL AND STEEL ARMOURED WIRES (M-695 SPEC CABLES), CONNECT BOTH ENDS OF THE ARMOUR SHEATH TO GROUND. REFER TO DRAWING DU-06-201 SHEET 2.
9. JUMPER AMPACITY SHOULD AT LEAST EQUAL CABLE AMPACITY.
10. ONE END OF THE PRIMARY SUBMARINE CABLE MUST HAVE FUSED PROTECTION.
11. REFER TO OVERHEAD DISTRIBUTION STANDARDS – SECTION 8 FOR CUTOUT AND ARRESTER SELECTION.

REFERENCES:

SECTION 1	DEFINITIONS
SECTION 6C	CONSTRUCTION GUIDE
SECTION 8	O/H – U/G TRANSITIONS
SECTION 16	MATERIALS LIST





CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
250	10"
600	2'-0"
900	3'-0"
1100	3'-7"
1200	4'-0"
1300	4'-4"
1500	5'-0"

Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	* *	* *	*			
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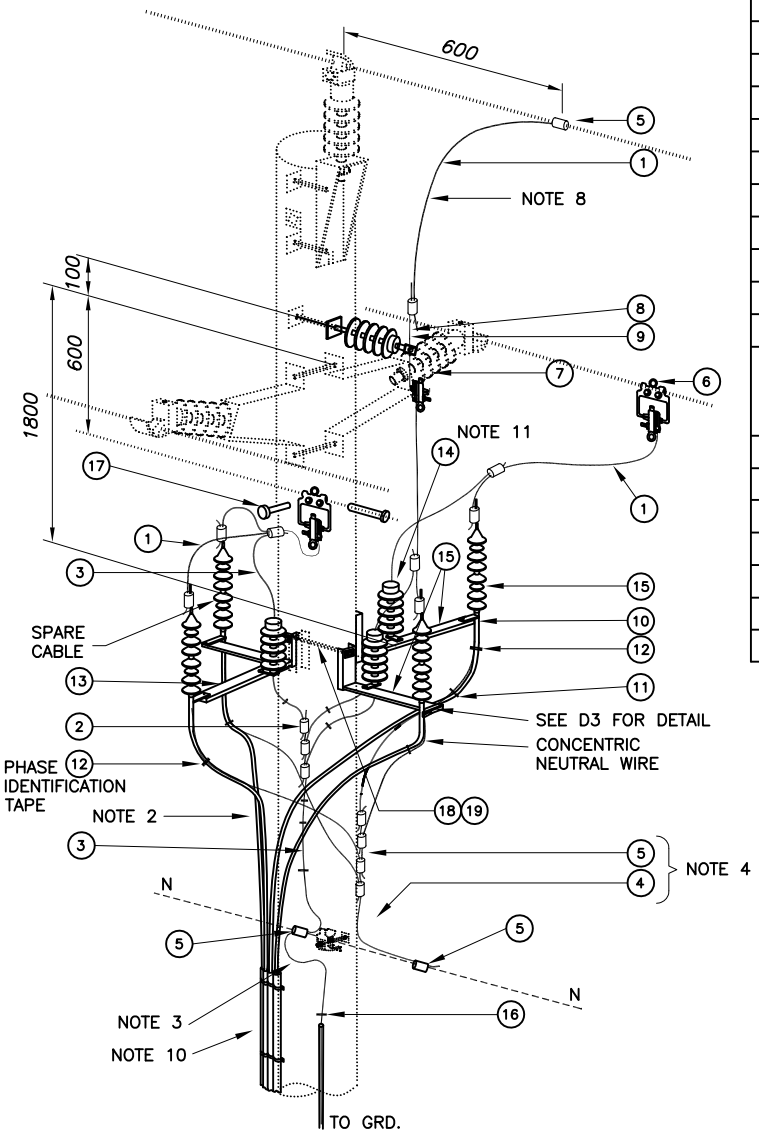
hydro one **Hydro One Networks Inc.**

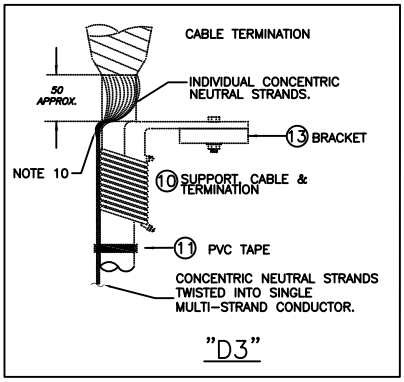
Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

FUSED PRIMARY SUBMARINE
CABLE TERMINATION - SPARE CABLE
-3 PHASE, 4 WIRE 2.4/4.18 - 16/27.6 kV

Dwg. No. DU-06-203 Rev. 02



PART #	MM #	DESCRIPTION	QTY.
1	30005821 30005823 30005825	BARE COND, COPPER, 1/0 AWG, MHD SAME--2/0 SAME--4/0	AS REQD
2	30006509	CONNECTOR, TAP COMP, 6AWG – 4AWG	3
3	30014480	BARE COND, COPPER, 4AWG, 7 STRAND, SD	AS REQD
4	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
5	AS REQD	CONNECTOR, TAP WEDGE, AMP	AS REQD
6	AS REQD	CONNECTOR, STIRRUP, BOLTED	2
7	30007392	CONNECTOR, LIVE LINE	3
8	30008425	INSULATOR, STANDOFF 28 kV	1
9	30000770	CLAMP REST, INSULATOR TYPE	2
10	30008041	SUPPORT, CABLE & TERMINATION	4
11	30008331	TAPE, ELECTRICAL, PVC, BLACK	AS REQD
12	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	AS REQD
13	30000825	BRACKET, CUTOUT/ARRESTER	3
14	AS REQD	ARRESTER, RISER POLE	4
15	30007446	TERMINATION, COLD SHRINK, 28 kV, 1/0	4
16	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	AS REQD
17	30000777	CLAMP REST, POLE TYPE	4
18	AS REQD	BOLT, 3/4" DIA.	AS REQD
19	30001595	WASHER, SQUARE, 3/4" x 2" x 2"	AS REQD

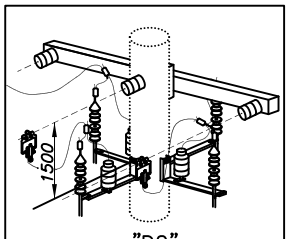


"D3"

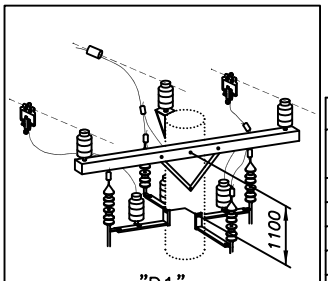
NOTES
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
3. SLACK LOOP OF GROUND WIRE.
4. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
5. FOR PRIMARY AND SUBTRANSMISSION CABLES WITH SEPARATE CONCENTRIC NEUTRAL AND STEEL ARMOURED WIRES (M-695 SPEC CABLES), CONNECT BOTH ENDS OF THE ARMOUR SHEATH TO GROUND. REFER TO DRAWING DU-06-202 SHEET 2.
6. FOLD BACK, BUNDLE TOGETHER, ATTACH TO CABLE BY TAPE, AND THEN CONNECT TO NEUTRAL.
7. FOR EXPOSED ENDS OF PE COVERED STEEL ARMOURED (M-695) CABLE, ALWAYS SUSPEND CABLE POINTING DOWNWARDS TO STOP MOISTURE INGRESS.
8. JUMPER AMPACITY SHOULD AT LEAST EQUAL CABLE AMPACITY.
9. OTHER END OF THE PRIMARY SUBMARINE CABLE MUST HAVE FUSED PROTECTION.
10. THE PREFERRED INSTALLATION FOR CABLES ON A POLE IS COVERED BY METAL GUARDS AS PER DU-08-302. STANDOFF BRACKETS MAY BE USED WHERE AERIAL DEVICE ACCESS IS UNAVAILABLE. REFER TO DU-06-403.
11. REFER TO OVERHEAD DISTRIBUTION STANDARDS – SECTION 8 FOR CUTOUT AND ARRESTER SELECTION.

REFERENCES:

SECTION 1	DEFINITIONS
SECTION 6C	CONSTRUCTION GUIDE
SECTION 8	O/H – U/G TRANSITIONS
SECTION 16	MATERIALS LIST



"D2"
ARRANGEMENT ON 3-PH DEADEND FRAMINGS



"D1"
ARRANGEMENT ON 3-PH CROSSARM FRAMINGS

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
250	10"
600	2'-0"
1100	3'-7"
1500	5'-0"
1800	6'-0"

Rev. No.	Issue Date	Revision	Dwn	Approved By
*	*	*	*	
02	NOV 2011	REDRAWN WITH EDITORIAL CHANGES & REDRAWN DETAIL D3	*	*
			Chk	Date

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

UNFUSED PRIMARY SUBMARINE CABLE TERMINATION - SPARE CABLE -3 PHASE, 2.4/4.18 - 16/27.6 kV

Dwg. No. DU-06-203A Rev. 02

SUB-SECTION 6C (c)
THREE PHASE DISTRIBUTION
44kV
SUBMARINE INSTALLATIONS

Sub- Section 6C (c)
44 kV Three-Phase Distribution

In This Section

This section details the various construction related requirements for the installation of 44 kV Three-Phase Distribution Submarine Systems.

This Section is divided into Sub-sections as follows:

Note: Sub-Section 6C (c) - 5 through -7 will be similar in content to Sub-Section 6C (b) -5 through -7 with the following major differences and exceptions:

1- The significant difference between three-phase up to 16/27.6 kV and 44 kV is the primary cable design. This is detailed in the Design Guide; Sub-Section 6D (c). Only M-695 cables are used for 44 kV installations.
2- 44 kV lines may not have a neutral.
3- Clearances and limit of approach for 44 kV O/H shall be per Overhead Distribution Standards; Section 6.
4- There is no padmount equipment at 44 kV.

Sub-Section 6C (c) – 1
General

Scope

This section applies to the installation of standard, 44 kV three-phase submarine distribution systems that:

- typically serve customers on islands or along the shorelines of lakes
- form part of the sub-transmission network crossing a body of water
- are owned by Hydro One Networks Inc. (Hydro One)

Purpose

The purpose of this section is to provide direction and support to constructors for the installation of submarine cable systems and to inspectors for inspection of constructed facilities.

This construction guide is prepared to ensure that:

a) the submarine distribution systems, owned by Hydro One are constructed on a consistent basis to provide for safe and reliable operation, and

b) only use materials approved by Hydro One for the construction of such submarine distribution systems.

General Rules

Submarine distribution systems, owned by Hydro One shall be constructed in accordance with the Hydro One approved design and layout drawings and shall comply with these standards. Any proposed deviation from these standards shall be submitted to and approved by Hydro One prior to construction.

All customer-owned equipment shall comply with the Ontario Electrical Safety Code.

Safety

All construction shall be carried out with adequate safeguards to minimize the risk to the public, the workers and existing structures. All applicable construction safety requirements of Hydro One, OH&SA, Ministry of Natural Resources, local Municipalities and other regulators shall be followed.

As Built Drawings

Upon completion of construction, signed and red-lined “as-built” drawings shall be submitted to Hydro One.

Sub-Section 6C (c) – 2
Cable Installation – Subtransmission

General

Construction standards for 44 kV three-phase cable installations shall be consistent with the construction standard for single phase cable installation as detailed in Sub-Section 6C (a) -2.

Subtransmission Cable

A three-phase subtransmission cable installation shall consist of three individual single-conductor cables.

The subtransmission cable shall be in accordance with Hydro One Standard Specifications M-695.

The standard M-695 cable system is single conductor, submarine cable with copper core, cross-linked polyethylene (TRXLPE) insulation, copper concentric neutral, polyethylene jacket, individually jacketed steel wire armour and jute or hessian cover. The 46 kV cables (phase-phase) are suitable for operation on 3 wire sub-transmission systems up to and including 44 kV.

Minimum Bending Radius

The bending radii of commonly used M-695 cable for submarine sub-transmission applications are given in Table 3:

Table 3

Bending Radius of M-695 Cable
mm [Inch]

Conductor Size kcmil	Cable with tinned copper concentric neutral and individually jacketed steel wire armour.
350 (46 kV)	786 [31]
500 (46 kV)	840 [33]
750 (46 kV)	932 [37]
1000 (46 kV)	972 [38]

Note: For the bending radius of the other sizes refer to the manufacturer data on outer diameter of the cable.

Sub-Section 6C (c) – 3
Overhead to Underground Transition

General

Construction standards for 44kV overhead to underground transitions shall be consistent with the construction standard for three-phase transitions detailed in Sub-Section 6C (b) -3 with additions and exceptions indicated below.

Subtransmission Cable Installation

Pole-mounted subtransmission submarine cables shall be installed with cold shrink terminations. The cable and its termination shall be adequately supported on the riser and dip poles as shown on drawings DU-06-501 and 502.

Drawing DU-06-502 provides the arrangement for accommodating a spare cable. The spare cable is mounted on a separate bracket. The spare cable is not to be paralleled but connected only at one end. The other end of the cable should be supported on a stand-off insulator and not connected to the line.

Armour Shield

The armour of the 44 kV submarine cables on riser and dip poles shall be grounded at both ends of the cable section. The concentric neutral shall be grounded at both ends.

Refer to Drawings DU-06-501 Sheet 2/2 for concentric neutral and armour grounding of M-695 cable on 3-wire 44 kV systems.

If there is an under-built primary circuit neutral the concentric neutral of the 44 kV cable may be bonded to that neutral as shown in DU-06-202 Sheet 2.

Cutout/Surge Arrester

For each cable (excluding the spare cable if provided), one metal oxide surge arrester shall be mounted on the dip pole using standard mounting hardware.

Arrester protection is required at both ends of cable section. Fuse protection is not provided for 44kV cables as the cable is protected by the station breaker.

Sub-Section 6C (c) – 4
Grounding

General

Grounding standards for 44kV submarine cable installations shall be consistent with the construction standard for three-phase submarine cable grounding, detailed in Sub-Section 6C (b) -4 with additions and exceptions indicated below.

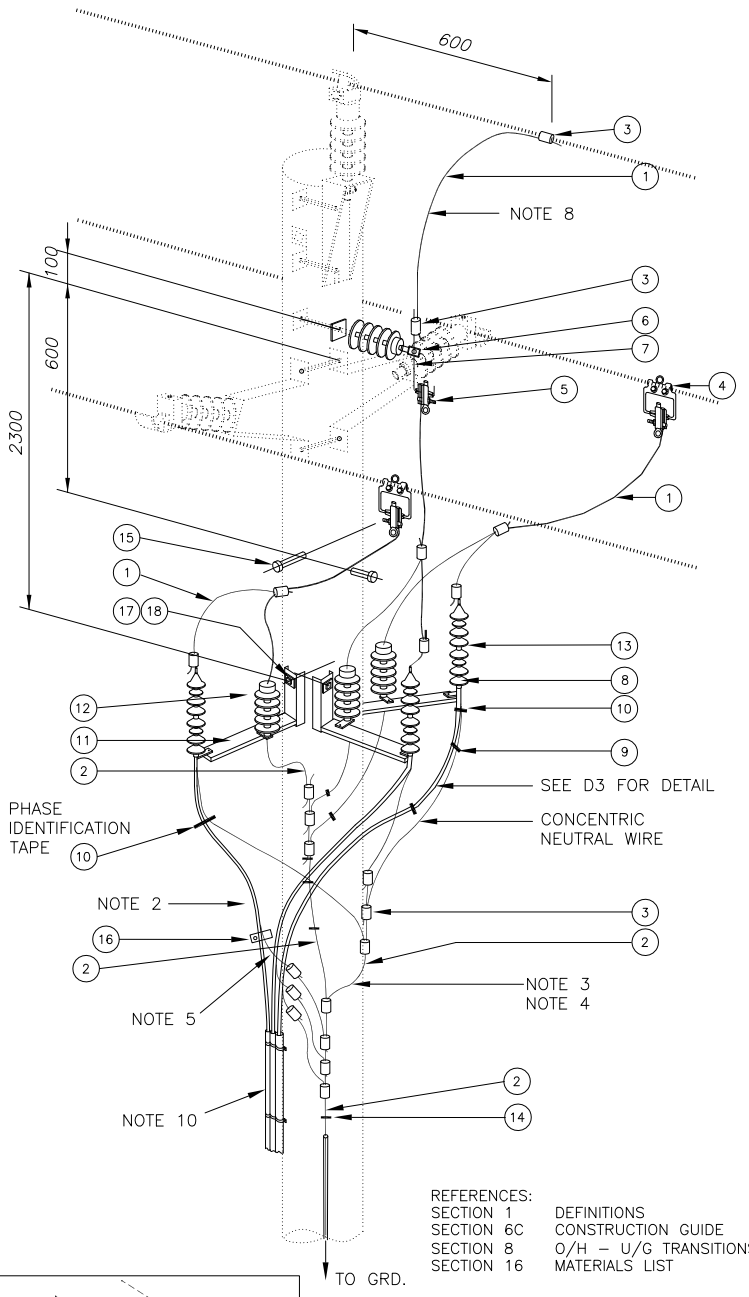
Grounding Conductor

Ground conductors used shall be bare copper 1/0, 7 strands. The riser pole ground conductor shall be bare copper, 1/0 AWG, 7 strands for 3-wire subtransmission circuits. The connections from armour wires and concentric neutral wires to the pole ground conductor, if required, shall be bare copper 1/0, 7 strands, as indicated in the drawings in Section 6C (c) -8.

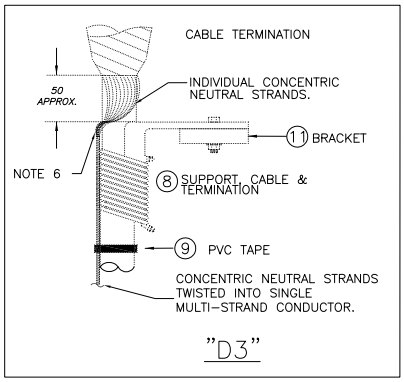
Sub-Section 6C (c) – 8
References and Drawings

In This Section This section contains the following drawings:

Description	Dwg. #	Rev.
Un-fused 44kV Submarine Cable Termination – 3-phase	DU-06-501	R2
Un-fused 44kV Submarine Cable Termination – Spare Cable – 3-phase	DU-06-502	R2



PART #	MM #	DESCRIPTION	QTY.
①	30005821 30005823 30005825	BARE COND, COPPER, 1/0 AWG, MHD SAME--2/0 SAME--4/0	AS REQD
②	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
③	AS REQD	CONNECTOR, TAP WEDGE, AMP	AS REQD
④	AS REQD	CONNECTOR, STIRRUP, BOLTED	2
⑤	30007392 30006969	CONNECTOR, LIVE LINE, 400A CONNECTOR, LIVE LINE, 600A	3 3
⑥	10000412	INSULATOR, STANDOFF 46 kV	1
⑦	30000770	CLAMP REST, INSULATOR TYPE	1
⑧	30008041	SUPPORT, CABLE & TERMINATION	3
⑨	30008331	TAPE, ELECTRICAL, PVC, BLACK	AS REQD
⑩	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	AS REQD
⑪	30000846	BRACKET, CUTOUT/ARRESTER	1
⑫	10000230	ARRESTER, RISER POLE	3
⑬	30007458	TERMINATION, COLD SHRINK, 44 kV, 1000kcm, OR USE OTHER SIZES AS REQUIRED.	3
⑭	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	AS REQD
⑮	30000777	CLAMP REST, POLE TYPE	3
⑯	30003502	CLAMP, GEAR TYPE	3
⑰	AS REQD	BOLT, 3/4" DIA.	AS REQD
⑱	30001595	WASHER, SQUARE, 3/4" x 2" x 2"	AS REQD

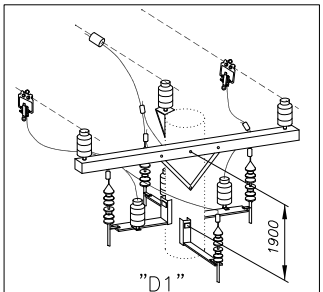


"D3"

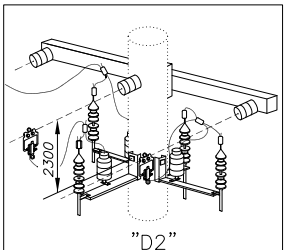
REFERENCES:

SECTION 1	DEFINITIONS
SECTION 6C	CONSTRUCTION GUIDE
SECTION 8	O/H – U/G TRANSITIONS
SECTION 16	MATERIALS LIST

NOTES
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
3. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE GROUND.
4. IF THERE IS A NEUTRAL ON THE POLE, THE CABLE CONCENTRIC NEUTRAL MAY BE BONDED TO IT. SEE DU-06-202.
5. FOR SUBTRANSMISSION CABLES WITH SEPARATE CONCENTRIC NEUTRAL AND STEEL ARMOURED WIRES (M-695 SPEC CABLES), CONNECT BOTH ENDS OF THE ARMOUR SHEATH TO GROUND. REFER TO DRAWING DU-06-501 SHEET 2.
6. FOLD BACK, BUNDLE TOGETHER, ATTACH TO CABLE BY TAPE, AND THEN CONNECT TO GROUND.
7. FOR EXPOSED ENDS OF PE COVERED STEEL ARMOURED CABLE, ALWAYS SUSPEND CABLE POINTING DOWNWARDS TO STOP MOISTURE INGRESS. REMOVE PE COVER NEAR CONNECTOR
8. JUMPER AMPACITY SHOULD AT LEAST EQUAL CABLE AMPACITY.
9. OTHER END OF THE SUBMARINE CABLE MAY HAVE A SOLID BLADE SWITCH. OVERCURRENT PROTECTION IS PROVIDED BY STATION CIRCUIT BREAKER.
10. THE PREFERRED INSTALLATION FOR CABLES ON A POLE IS COVERED BY METAL GUARDS AS PER DU-08-302. STANDOFF BRACKETS MAY BE USED WHERE AERIAL DEVICE ACCESS IS UNAVAILABLE. REFER TO DU-06-403.



"D1"
ARRANGEMENT ON 3-PH CROSSARM FRAMINGS



"D2"
ARRANGEMENT ON 3-PH DEADEND FRAMINGS

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
250	10"
600	2'-0"
1100	3'-7"
1500	5'-0"
1800	6'-0"

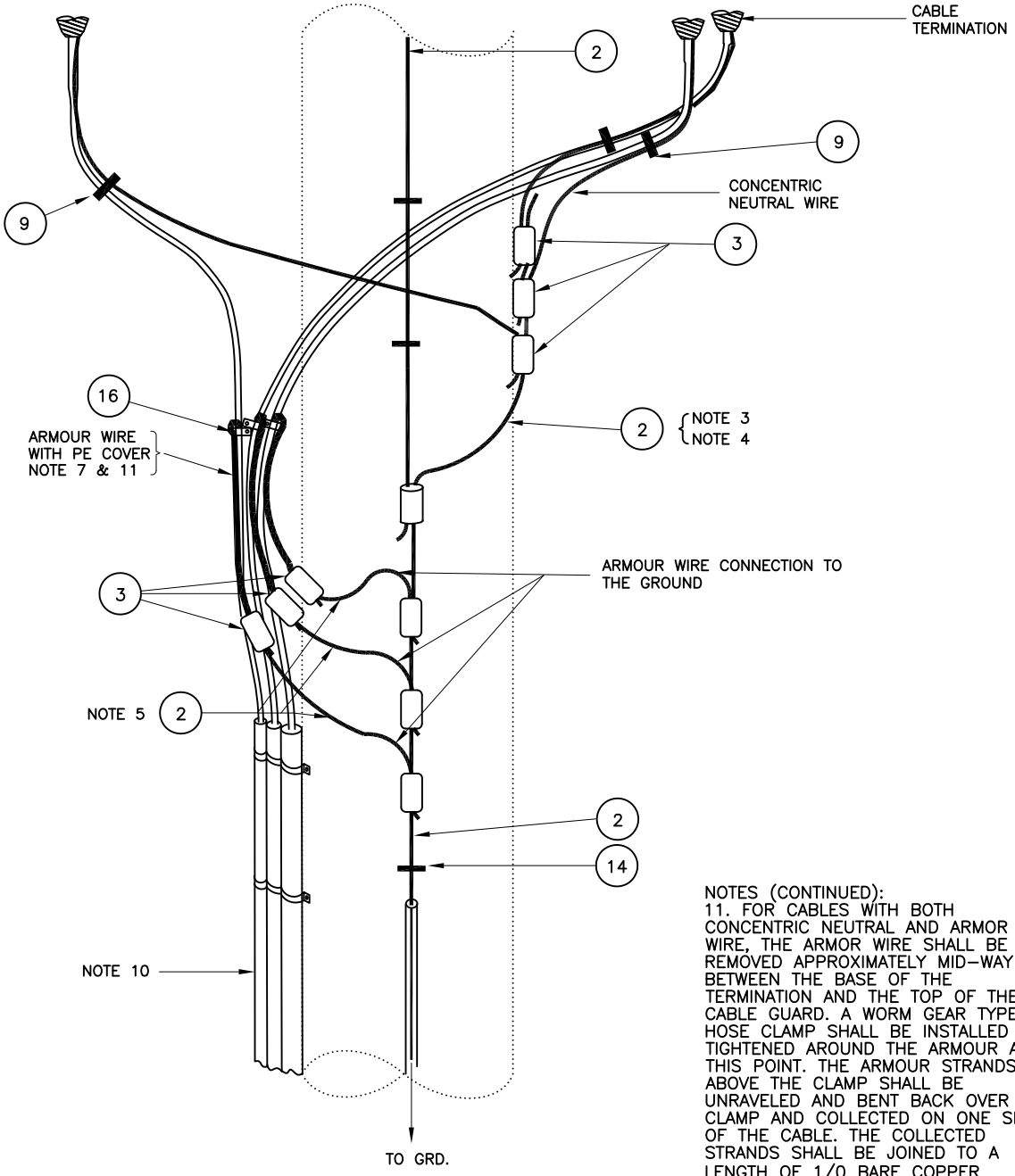
Rev. No.	Issue Date	Revision	Dwn	Approved By
*	* *	*	*	
02	NOV 2011	CORRECTED PARTS LIST AND RE-DRAWN DETAIL D3	*	*
			Chk	Date

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

UNFUSED 44KV SUBMARINE CABLE TERMINATION
- 3 PHASE, 44KV

Dwg. No. DU-06-501 SHT. 1 OF 2 Rev. 02



CONCENTRIC NEUTRAL AND ARMOURED CONNECTION FOR SUBTRANSMISSION CABLE – M–695 SPEC

NOTES (CONTINUED):
11. FOR CABLES WITH BOTH CONCENTRIC NEUTRAL AND ARMOR WIRE, THE ARMOR WIRE SHALL BE REMOVED APPROXIMATELY MID–WAY BETWEEN THE BASE OF THE TERMINATION AND THE TOP OF THE CABLE GUARD. A WORM GEAR TYPE HOSE CLAMP SHALL BE INSTALLED AND TIGHTENED AROUND THE ARMOUR AT THIS POINT. THE ARMOUR STRANDS ABOVE THE CLAMP SHALL BE UNRAVELED AND BENT BACK OVER THE CLAMP AND COLLECTED ON ONE SIDE OF THE CABLE. THE COLLECTED STRANDS SHALL BE JOINED TO A LENGTH OF 1/0 BARE COPPER CONDUCTOR WITH AN APPROPRIATE CONNECTOR.

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 16 MATERIALS LIST

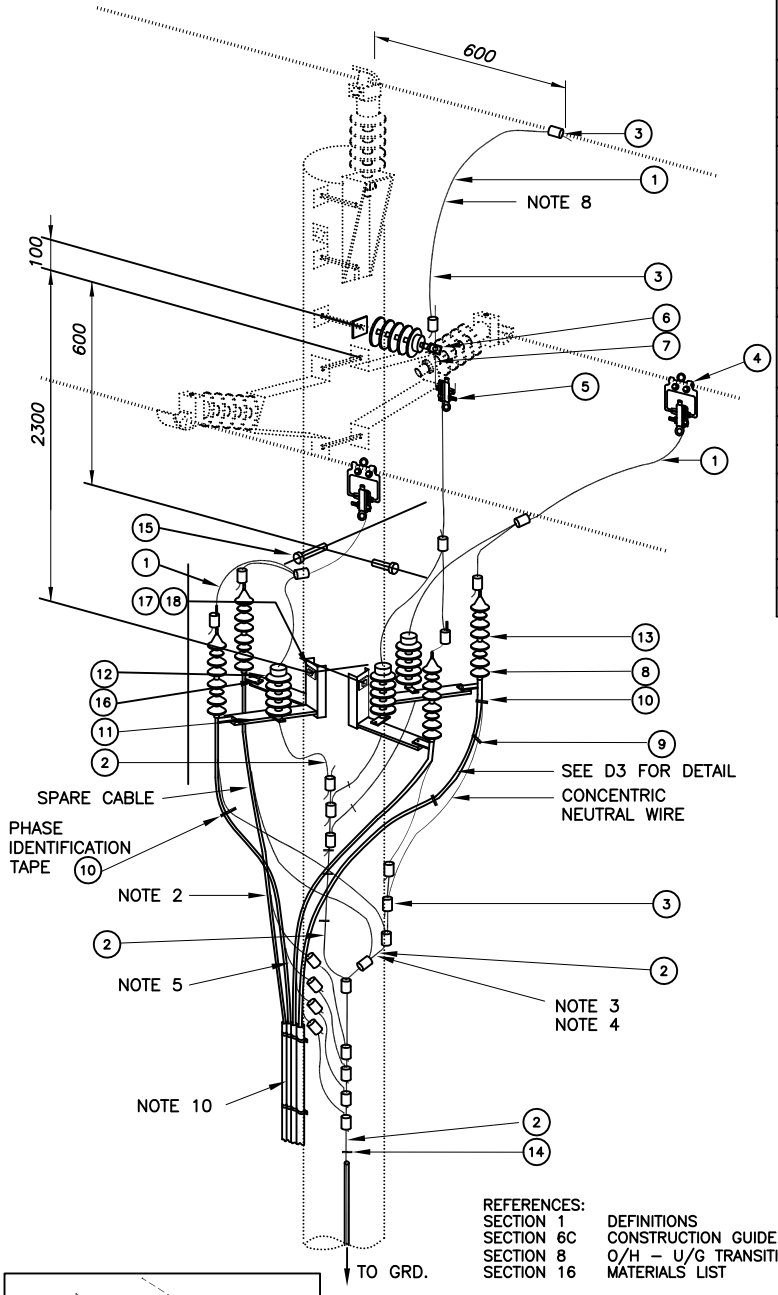
Rev. No.	Issue Date	Revision	Dwn	Approved By / Date
*	* *	* *	*	
02	NOV 2011	CORRECTED PARTS LIST AND RE–DRAWN DETAIL D3	*	

hydro one **Hydro One Networks Inc.**

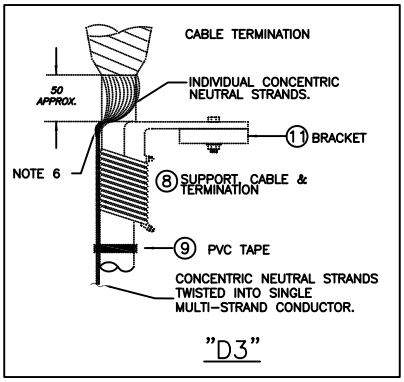
Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

UNFUSED 44KV SUBMARINE CABLE TERMINATION - 3 PHASE, 44KV

Dwg. No. DU-06-501 SHT. 2 OF 2 Rev. 02



PART #	MM #	DESCRIPTION	QTY.
①	30005821 30005823 30005825	BARE COND, COPPER, 1/0 AWG, MHD SAME--2/0 SAME--4/0	AS REQD
②	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	AS REQD
③	AS REQD	CONNECTOR, TAP WEDGE, AMP	AS REQD
④	AS REQD	CONNECTOR, STIRRUP, BOLTED	2
⑤	30007392 30006969	CONNECTOR, LIVE LINE, 400A CONNECTOR, LIVE LINE, 600A	3 3
⑥	10000412	INSULATOR, STANDOFF 46 kV	1
⑦	30000770	CLAMP REST, INSULATOR TYPE	1
⑧	30008041	SUPPORT, CABLE & TERMINATION	4
⑨	30008331	TAPE, ELECTRICAL, PVC, BLACK	AS REQD
⑩	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	AS REQD
⑪	30000846	BRACKET, CUTOUT/ARRESTER	3
⑫	10000230	ARRESTER, RISER POLE	3
⑬	30007458	TERMINATION, COLD SHRINK, 44 kV, 1000kcm, OR USE OTHER SIZES AS REQUIRED.	4
⑭	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	AS REQD
⑮	30000777	CLAMP REST, POLE TYPE	3
⑯	10000049	BRACKET, CABLE	1
⑰	AS REQD	BOLT, 3/4" DIA.	AS REQD
⑱	30001595	WASHER, SQUARE, 3/4" x 2" x 2"	AS REQD

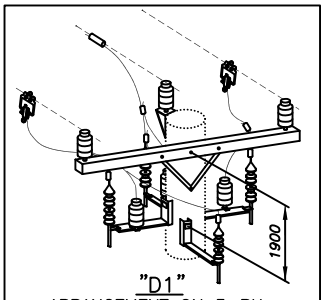


"D3"

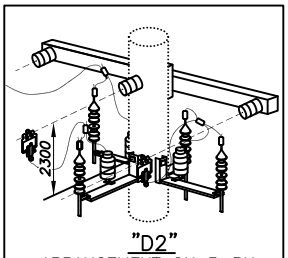
REFERENCES:

SECTION 1	DEFINITIONS
SECTION 6C	CONSTRUCTION GUIDE
SECTION 8	O/H – U/G TRANSITIONS
SECTION 16	MATERIALS LIST

NOTES
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 12 X DIAMETER OF CABLE.
3. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE GROUND.
4. IF THERE IS A NEUTRAL ON THE POLE, THE CABLE CONCENTRIC NEUTRAL MAY BE BONDED TO IT. SEE DU-06-202.
5. FOR SUBTRANSMISSION CABLES WITH SEPARATE CONCENTRIC NEUTRAL AND STEEL ARMOURED WIRES (M-695 SPEC CABLES), CONNECT BOTH ENDS OF THE ARMOUR SHEATH TO GROUND. REFER TO DRAWING DU-06-501 SHEET 2.
6. FOLD BACK, BUNDLE TOGETHER, ATTACH TO CABLE BY TAPE, AND THEN CONNECT TO GROUND.
7. FOR EXPOSED ENDS OF PE COVERED STEEL ARMOURED (M-695) CABLE, ALWAYS SUSPEND CABLE POINTING DOWNWARDS TO STOP MOISTURE INGRESS.
8. JUMPER AMPACITY SHOULD AT LEAST EQUAL CABLE AMPACITY.
9. OTHER END OF THE SUBMARINE CABLE MAY HAVE A SOLID BLADE SWITCH. OVERCURRENT PROTECTION IS PROVIDED BY STATION CIRCUIT BREAKER.
10. THE PREFERRED INSTALLATION FOR CABLES ON A POLE IS COVERED BY METAL GUARDS AS PER DU-08-302. STANDOFF BRACKETS MAY BE USED WHERE AERIAL DEVICE ACCESS IS UNAVAILABLE. REFER TO DU-06-403.
11. THE SPARE CABLE IS NOT TO BE PARALLELED BUT CONNECTED ONLY AT ONE END. SUPPORT OTHER END ON A STAND-OFF INSULATOR.



"D1"
ARRANGEMENT ON 3-PH CROSSARM FRAMINGS



"D2"
ARRANGEMENT ON 3-PH DEADEND FRAMINGS

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
250	10"
600	2'-0"
1100	3'-7"
1500	5'-0"
1800	6'-0"

Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	*	*	*			
02	NOV 2011	REDRAWN WITH EDITORIAL CHANGES & RE-DRAWN DETAIL D3	*	*		

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
A. VIDAD	*	NOV.16,2011

UNFUSED 44KV SUBMARINE CABLE TERMINATION
- 3 PHASE, 44KV - SPARE CABLE

Dwg. No. DU-06-502 Rev. 02

SECTION 8
O/H TO U/G TRANSITIONS

Section 8-0
O/H-U/G Transitions

General

This Section deals with the design and installation of overhead to underground primary cable risers for system voltages up to 44 kV.

Riser/Dip Poles

Pole-mounted primary cables shall have cold shrink terminations. The cable and termination shall be adequately supported on the bracket or wire mesh grip, as shown on drawings in this section. The termination shall match the cable voltage rating and conductor size. The arrester and cutout rating shall match the system voltage.

Primary supply cables of all sizes on poles shall be protected by a metallic guard(except 2/0 Al which can be protected with rigid PVC conduit), from at least 600 mm below grade level, to the full length of cable run on the pole. The cable bending radius shall not be less than 10 times the cable diameter. To allow for ground settlement, some slack shall be kept on the cable at the pole base. Grounding conductors on poles shall be protected with a wood guard as shown on DU-08-301. Metal guards on poles shall be grounded through # 4 AWG copper wire, connected to a ground rod.

The concentric neutral of primary cables (up to 27.6 kV) on riser/dip poles shall be connected to the system neutral conductor, and shall be grounded at both ends of the cable section. Any deviation from this shall be approved by the Distribution Planner.

The concentric neutral of subtransmission cables (44 kV) on riser/dip poles shall be connected to the primary system neutral conductor (preferred when system neutral is available on the same pole as the termination) otherwise to the pole ground wire, and shall be grounded at both ends of the cable section. Any deviation from this shall be approved by the Distribution Planner.

For guidance on exceptional cases of single end grounding of concentric neutral, refer to section 13.

Faulted Circuit Indicators (FCI) on dip pole cables are not required if the cables are protected by fused cutout or pole mounted recloser.

Recloser Connected Termination

For achieving protection co-ordination with upstream protection devices and for high loads on cables, if three single-phase reclosers are used in place of fused cutouts at the dip pole, then they shall be installed and connected to primary cables as per DU-08-209. In such cases the reclosers shall be set to single-shot lockout (don't reclose on faulted cable or equipment).

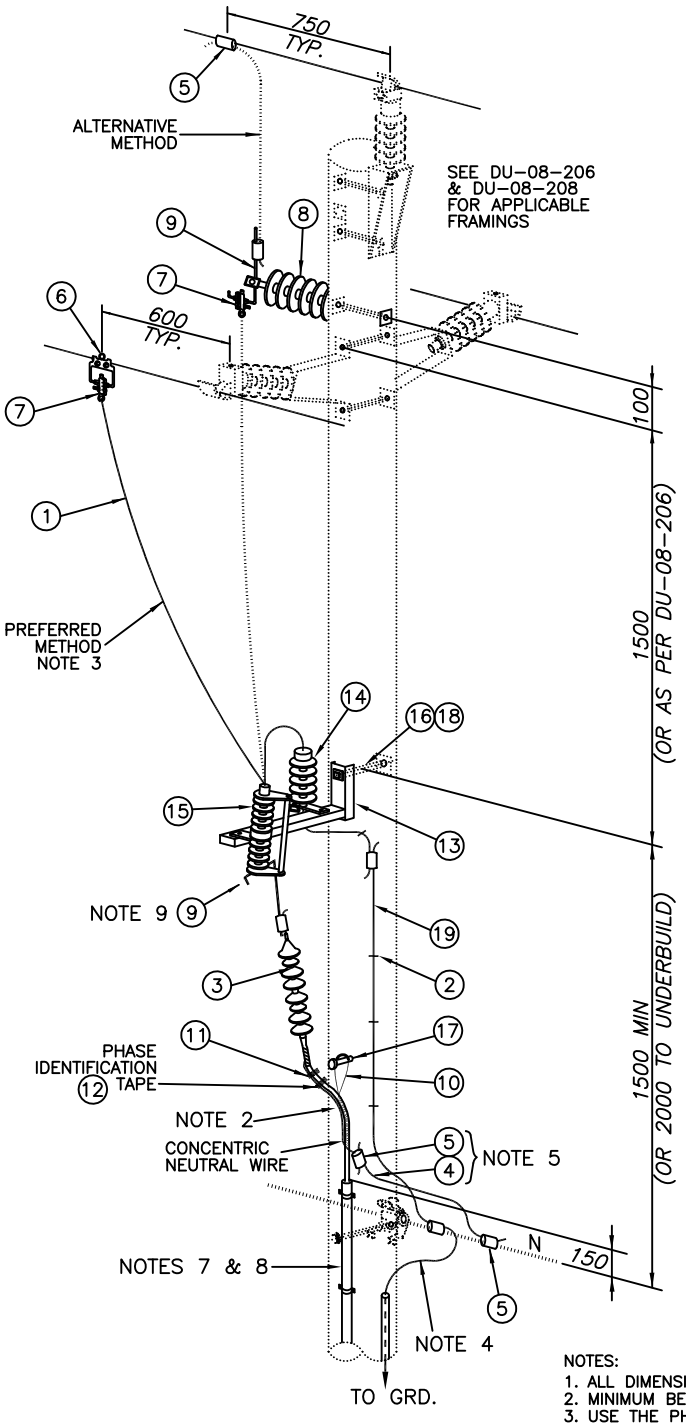
Separation to Communication Systems

Primary riser/dip cable plant shall be grouped in its own quadrant of the pole, and in a manner to permit the installation of Communications riser plant. None of the riser/dip plant installations shall interfere with the use of lineman's climbers.

In This Section This section contains the following drawings:

Description	Dwg. #	Rev.
Fused Primary Cable Termination – Single-Phase	DU-08-101	R2
Unswitched Primary Cable Termination – Single-Phase	DU-08-102	R2
Fused Primary Cable Termination – Three-Phase	DU-08-201	R2
Unswitched Primary Cable Termination – Three-Phase	DU-08-202	R2
Switched Primary Cable Termination- Three- Phase	DU-08-204	R0
Framing Dimensions- Switched O/H-U/G Transitions	DU-08-205	R0
Framing Dimensions- With Cutouts O/H-U/G Transitions	DU-08-206	R0
Framing Dimensions- Unswitched O/H-U/G Transitions	DU-08-207	R0
Applicable Framings for DU-08-206 and DU-08-207	DU-08-208	R0
Recloser Connected Cable Riser 28 kV 3 Phase (G&W)	DU-08-209	R0
Grounding Details at Primary Riser/Dip Pole – Typical	DU-08-301	R3
Cable Guard Application - Wood Poles	DU-08-302	R2
Standoff Bracket Installation Details	DU-08-303	R1
Installation of 1-phase U/G Secondary on O/H Transformer Pole	DU-08-401	R3
Installation of Customer Owned 3-Phase U/G Secondary on O/H Transformer	DU-08-402	R2
1-Phase OR 3-Phase Secondary O/H to U/G Transitions (Triplex or Quadruplex)	DU-08-405	R2
Open Wire Bus: Installation of 1-Phase U/G Secondary	DU-08-408	R2
Unswitched Cable Termination 44kV 600A	DU-08-501	R0

Note: Drawings DU-08-203, DU-08-403, DU-08-404, DU-08-406 and DU-08-407 were superseded by other drawings.



CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
150	6"
600	2'-0"
750	2'-6"
1500	5'-0"
2000	6'-8"

PART #	MM #	DESCRIPTION	QTY.
1	AS NEEDED	BARE COND, COPPER, MHD, AS REQ'D	A/R
2	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	A/R
3	AS NEEDED	TERMINATION, COLD SHRINK, 28kV	1
4	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	A/R
5	AS NEEDED	CONNECTOR, TAP WEDGE, AMP	A/R
6	30006184	CONNECTOR STIRRUP, BOLTED	1
7	30006195	CONNECTOR LIVE LINE	1
8	30008425	INSULATOR, STANDOFF, 28kV	1
9	30000770	CLAMP REST, INSULATOR TYPE	2
10	AS NEEDED	GRIP, CONDUCTOR, CLOSED MESH. (KELLEM)	1
11	30008340	TAPE, ELECTRICAL, PVC, BLACK	A/R
12	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	A/R
13	30000825	BRACKET, CUTOUT/ARRESTER	1
14	AS NEEDED	ARRESTER, AS REQ'D	1
15	AS NEEDED	CUTOUT, FUSED, AS REQ'D	1
16	AS NEEDED	BOLT, 3/4"	A/R
17	30001237	BOLT, LAG, 4" LONG	A/R
18	30001595	WASHER, 3/4" X 2" X 2"	A/R
19	30014480	BARE COND., COPPER, #4	A/R
		A/R = AS REQUIRED	

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 10 x DIAMETER OF CABLE.
3. USE THE PHASE REQUIRED FOR LOAD BALANCE AND EASE OF CONNECTION.
4. SLACK LOOP OF GROUND WIRE. ALL GROUNDS TO BE CONTINUOUS WHERE POSSIBLE.
5. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
6. DEAD END INSTALLATIONS NOT PREFERRED.
7. POSITION THE RIGID CONDUIT SO AS TO ACCOMMODATE THE NEUTRAL AND ANY JOINT USE REQUEST.
8. STANDOFF BRACKETS CAN BE USED IN AREAS WHERE NO BUCKET TRUCK ACCESSIBILITY IS AVAILABLE AND WHERE SEVERAL CABLES ON THE POLE MAKE IT DIFFICULT TO CLIMB, SEE DU-08-303.
9. POSITION CLAMP SO AS TO MAXIMIZE CLEARANCE FROM THE TERMINATION TO AN OPENED CUTOUT.

REFERENCES

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 16 – MATERIALS LIST
O/H DISTRIBUTION STANDARDS

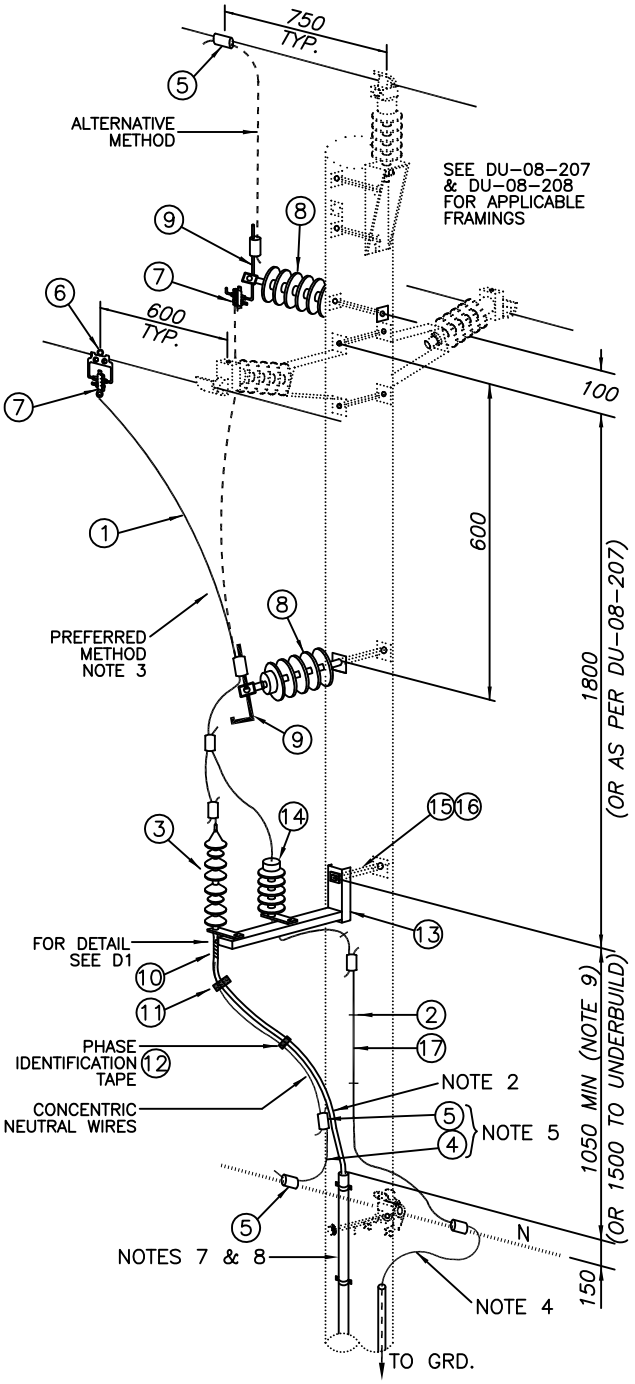
Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
02	OCT 2011	TERMINATING DIRECTLY ON CUTOUT, NOTES 6-9 ADDED & MM# ADDED	SO	*		
01	SEPT. 2006	GENERAL REVISIONS *	AM	DP	D.PARIKH	09/26/06

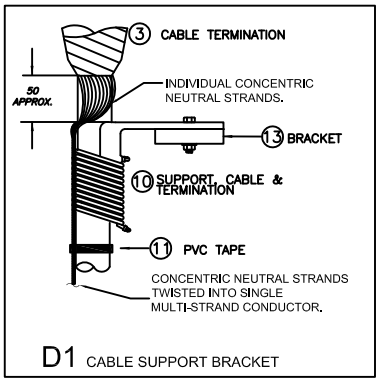
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV.11,2011

FUSED PRIMARY CABLE TERMINATION
- SINGLE-PHASE (MAX 400A)
2.4 TO 16kV

Dwg. No. DU-08-101 Rev. 02





D1 CABLE SUPPORT BRACKET

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
150	6"
600	2'-0"
750	2'-6"
1050	3'-6"
1500	5'-0"
1800	6'-0"

PART #	MM #	DESCRIPTION	QTY.
1	AS NEEDED	BARE COND, COPPER, MHD, AS REQ'D	A/R
2	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	A/R
3	AS NEEDED	TERMINATION, COLD SHRINK, 28kV	1
4	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	A/R
5	AS NEEDED	CONNECTOR, TAP WEDGE, AMP	A/R
6	30006184	CONNECTOR STIRRUP, BOLTED	1
7	30006195	CONNECTOR LIVE LINE	1
8	30008425	INSULATOR, STANDOFF 28kV	2
9	30000770	CLAMP REST, INSULATOR TYPE	2
10	30008041	SUPPORT, CABLE & TERMINATION	1
11	30008340	TAPE, ELECTRICAL, PVC, BLACK	A/R
12	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	A/R
13	30000825	BRACKET, CUTOUT/ARRESTER	1
14	AS NEEDED	ARRESTER, AS REQ'D	1
15	AS NEEDED	BOLT, 3/4"	A/R
16	30001595	WASHER, 3/4" X 2" X 2"	A/R
17	30014480	BARE COND, COPPER, #4	A/R
		A/R = AS REQUIRED	

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 10 x DIAMETER OF CABLE.
3. USE THE PHASE REQUIRED FOR LOAD BALANCE AND EASE OF CONNECTION.
4. SLACK LOOP OF GROUND WIRE. ALL GROUNDS TO BE CONTINUOUS WHERE POSSIBLE.
5. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
6. DEAD END INSTALLATIONS NOT PREFERRED.
7. POSITION THE RIGID CONDUIT SO AS TO ACCOMMODATE THE NEUTRAL AND ANY JOINT USE REQUEST.
8. STANDOFF BRACKETS CAN BE USED IN AREAS WHERE NO BUCKET TRUCK ACCESSIBILITY IS AVAILABLE AND WHERE SEVERAL CABLES ON THE POLE MAKE IT DIFFICULT TO CLIMB, SEE DU-08-303.
9. FOR LARGER CABLE SIZE IT IS RECOMMENDED TO INCREASE 1050mm BRACKET TO NEUTRAL CLEARANCE TO 1350mm.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 16 – MATERIALS
O/H DISTRIBUTION STANDARDS

Rev. No.	Issue Date	Revision	Dwn	Chk
02	OCT 2011	NEUTRAL POSITION REVISED, NOTES 6-9 ADDED, MM# ADDED	PC *	
01	SEPT. 2006	GENERAL REVISIONS *	AM DP	D.PARIKH 09/26/06

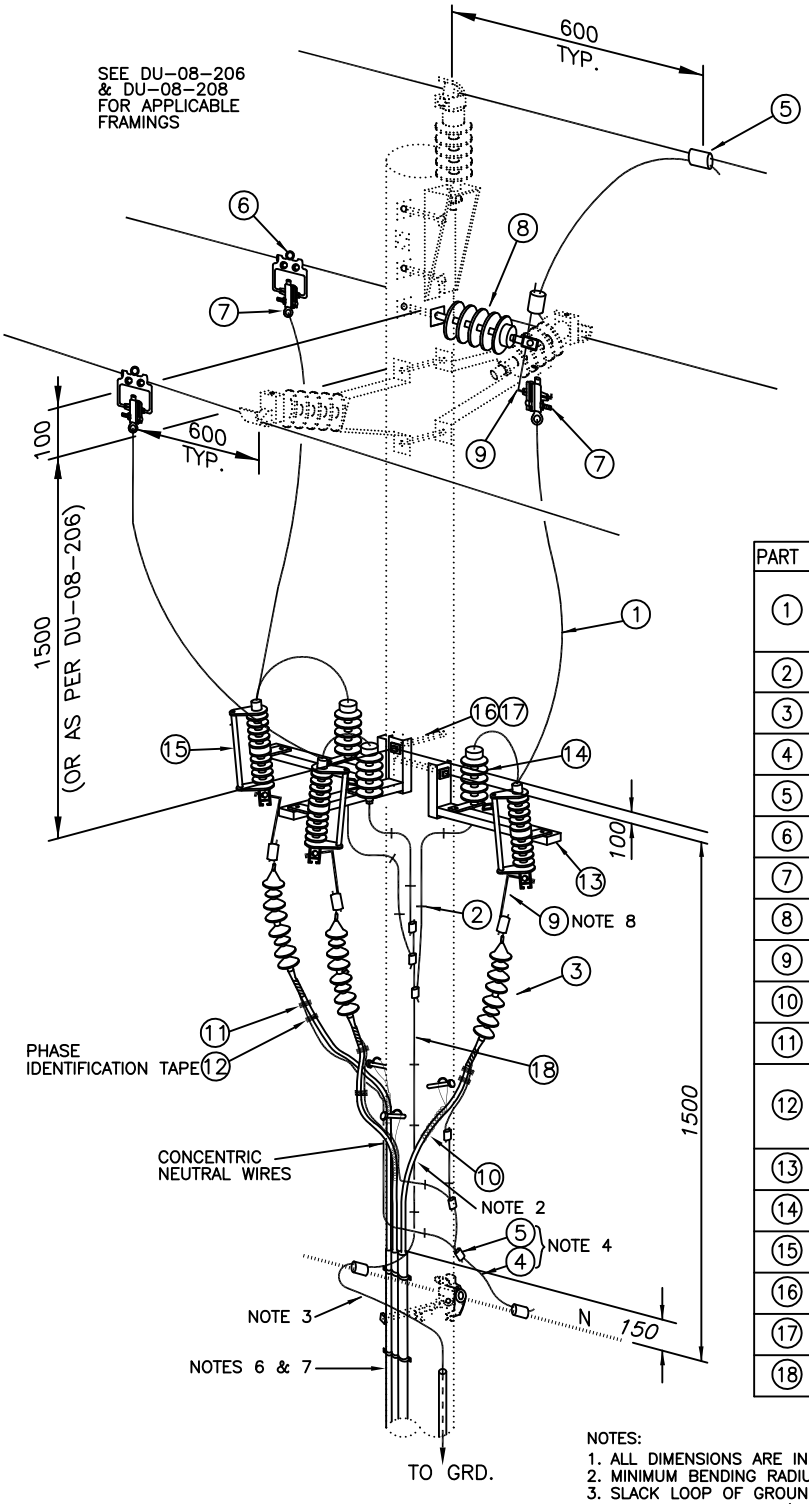
Approved By Date

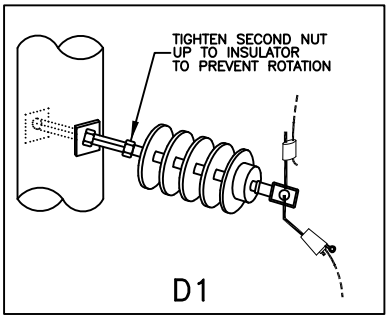
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
G.OKLECINSKI	*	NOV.11,2011

UNSWITCHED PRIMARY CABLE TERMINATION
- SINGLE-PHASE (MAX 400A)
2.4 TO 16kV

Dwg. No. DU-08-102 Rev. 02





CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
150	6"
600	2'-0"
1500	5'-0"

PART #	MM #	DESCRIPTION	QTY.
1	30005821 30005823 30005825	BARE COND, COPPER, 1/0 AWG MHD SAME--2/0 SAME--4/0	A/R
2	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	A/R
3	30007447	TERMINATION, COLD SHRINK, 28kV	3
4	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	A/R
5	AS NEEDED	CONNECTOR, TAP WEDGE, AMP	A/R
6	30006184 30006968	CONNECTOR STIRRUP, BOLTED	2
7	30007392	CONNECTOR LIVE LINE	3
8	30008425	INSULATOR, STANDOFF, 28kV	1
9	30000770	CLAMP REST, INSULATOR TYPE	4
10	AS NEEDED	GRIP, CONDUCTOR, CLOSED MESH.	3
11	30008331	TAPE, ELECTRICAL, PVC, BLACK	A/R
12	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	A/R
13	30000825	BRACKET, CUTOUT/ARRESTER	3
14	AS NEEDED	ARRESTER, RISER POLE, AS REQ'D	3
15	AS NEEDED	CUTOUT, FUSED, AS REQ'D	3
16	AS NEEDED	BOLT, 3/4"	A/R
17	30001595	WASHER, 3/4" X 2" X 2"	A/R
18	30005813	BARE COND, COPPER, #4 AWG	A/R
		A/R = AS REQUIRED	

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 10 x DIAMETER OF CABLE.
3. SLACK LOOP OF GROUND WIRE. ALL GROUNDS TO BE CONTINUOUS WHERE POSSIBLE.
4. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
5. DEAD END INSTALLATIONS NOT PREFERRED.
6. POSITION THE RIGID CONDUIT SO AS TO ACCOMMODATE THE NEUTRAL AND ANY JOINT USE REQUEST.
7. STANDOFF BRACKETS CAN BE USED IN AREAS WHERE NO BUCKET TRUCK ACCESSIBILITY IS AVAILABLE AND WHERE SEVERAL CABLES ON THE POLE MAKE IT DIFFICULT TO CLIMB, SEE DU-08-303.
8. POSITION CLAMP SO AS TO MAXIMIZE CLEARANCE TO AN OPENED CUTOUT.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 16 – MATERIALS
O/H DISTRIBUTION STANDARDS

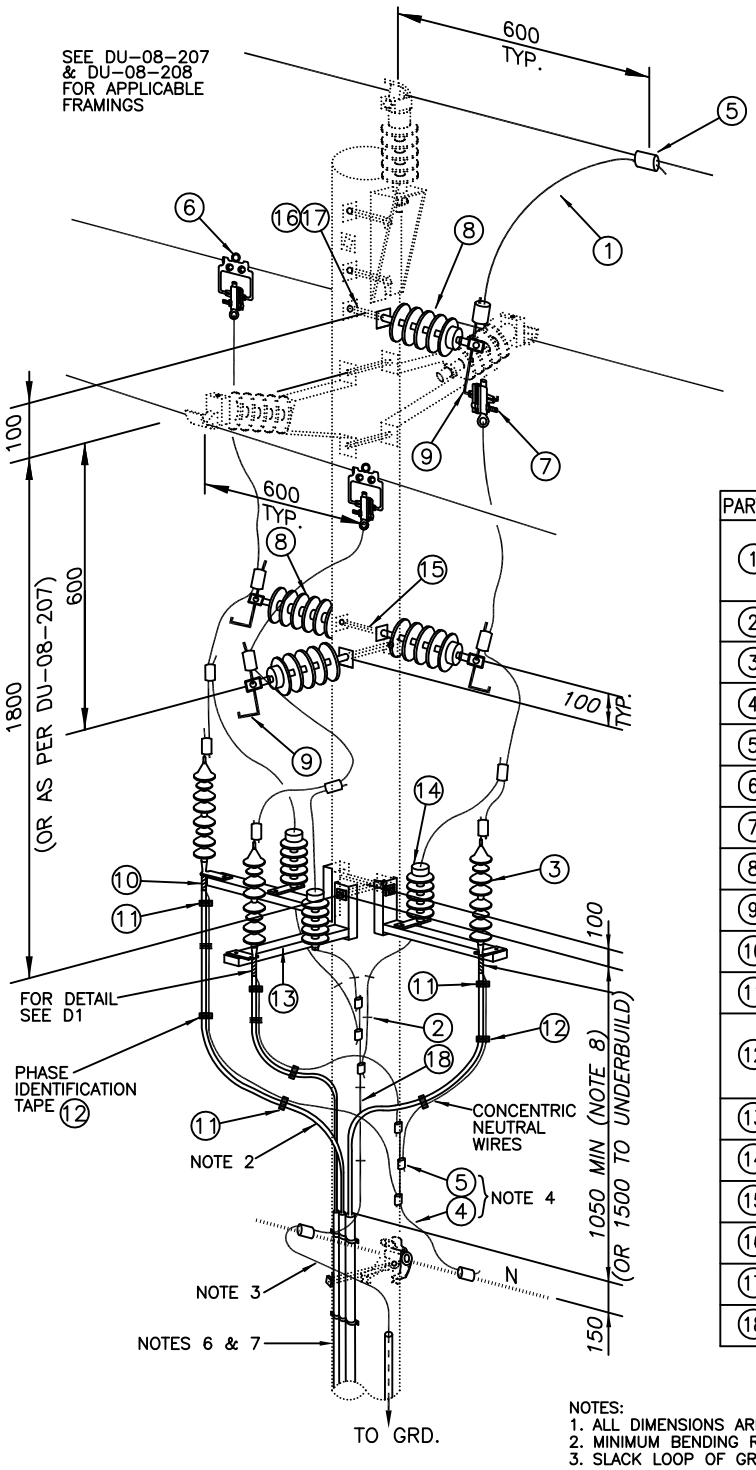
Rev. No.	Issue Date	Revision	Dwn	Approved By / Chk Date
02	NOV03 2011	TERMINATING DIRECTLY ON CUTOUT, NOTES 5-8 ADDED & MM# ADDED	GO *	
01	SEPT. 2006	GENERAL REVISIONS *	AM DP	D.PARIKH 09/26/06

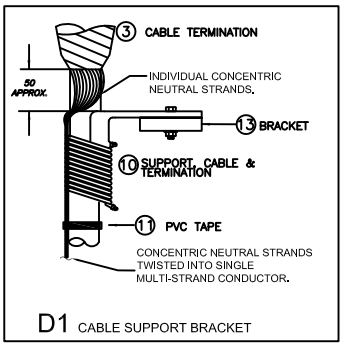
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
G.OKLECINSKI	*	NOV. 11, 2011

FUSED PRIMARY CABLE TERMINATION
- THREE-PHASE (MAX 400A)
2.4/4.8 TO 16/27.6kV

Dwg. No. DU-08-201 Rev. 02





D1 CABLE SUPPORT BRACKET

CONVERSION TABLE			
METRIC (mm)	IMPERIAL (APPROX)	METRIC (mm)	IMPERIAL (APPROX)
50	2"	600	2'-0"
100	4"	1050	3'-6"
150	6"	1800	6'-0"

PART #	MM #	DESCRIPTION	QTY.
(1)	30005821 30005823 30005825	BARE COND, COPPER, 1/0 AWG MHD SAME--2/0 SAME--4/0	A/R
(2)	30013881	STAPLE, GROUND WIRE, 3/8" x 1-1/2"	A/R
(3)	30007447	TERMINATION, COLD SHRINK, 28kV	3
(4)	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	A/R
(5)	AS NEEDED	CONNECTOR, TAP WEDGE, AMP	A/R
(6)	30006184 30006968	CONNECTOR STIRRUP, BOLTED	2
(7)	30007392	CONNECTOR LIVE LINE	3
(8)	30008425	INSULATOR, STANDOFF, 28kV	4
(9)	30000770	CLAMP REST, INSULATOR TYPE	4
(10)	30008041	SUPPORT, CABLE & TERMINATION	3
(11)	30008331	TAPE, ELECTRICAL, PVC, BLACK	A/R
(12)	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	A/R
(13)	30000825	BRACKET, CUTOUT/ARRESTER	3
(14)	AS NEEDED	ARRESTER, RISER POLE, AS REQ'D	3
(15)	AS NEEDED	BOLT, DOUBLE ARMING, 3/4"	1
(16)	AS NEEDED	BOLT, 3/4"	A/R
(17)	30001595	WASHER, 3/4" X 2" X 2"	1
(18)	30005813	BARE COND, COPPER, #4 AWG	A/R
		A/R = AS REQUIRED	

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 10 x DIAMETER OF CABLE.
3. SLACK LOOP OF GROUND WIRE. ALL GROUNDS TO BE CONTINUOUS WHERE POSSIBLE.
4. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
5. DEAD END INSTALLATIONS NOT PREFERRED.
6. POSITION THE RIGID CONDUIT SO AS TO ACCOMMODATE THE NEUTRAL AND ANY JOINT USE REQUEST.
7. STANDOFF BRACKETS CAN BE USED IN AREAS WHERE NO BUCKET TRUCK ACCESSIBILITY IS AVAILABLE AND WHERE SEVERAL CABLES ON THE POLE MAKE IT DIFFICULT TO CLIMB, SEE DU-08-303.
8. FOR LARGER CABLES IT IS RECOMMENDED TO INCREASE 1050 BRACKET TO NEUTRAL SEPARATION TO 1350.

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 16 – MATERIALS
O/H DISTRIBUTION STANDARDS

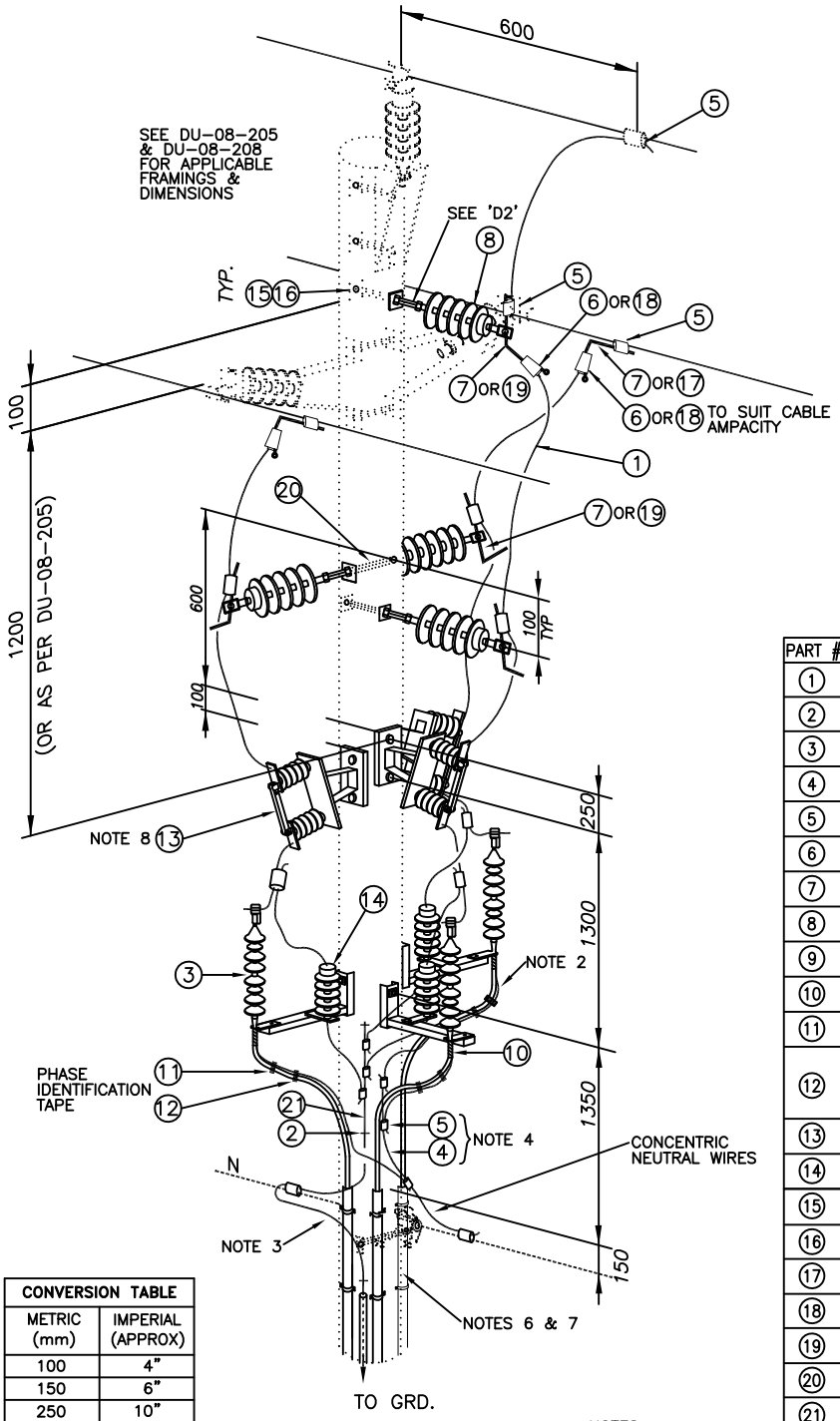
Rev. No.	Issue Date	Revision	PC / Dwn	Approved By / Chk Date
02	NOV03 2011	NEUTRAL POSITION REVISED, NOTES 5-8 ADDED & MM# ADDED	*	
01	SEPT. 2006	GENERAL REVISIONS *	AM / DP	D.PARIKH 09/26/06

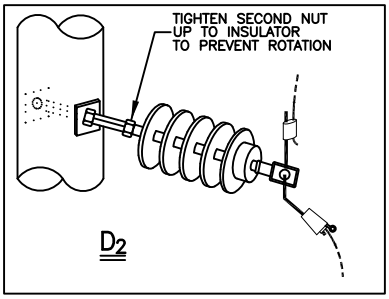
hydro one **Hydro One Networks Inc.**

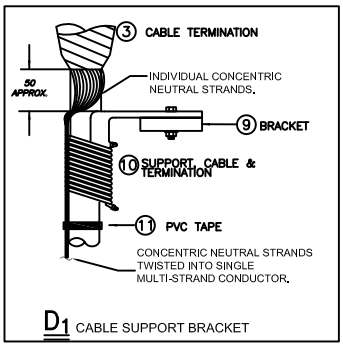
Drawn:	Approved:	Date:
G.OKLECINSKI	*	NOV. 11, 2011

UNSWITCHED PRIMARY CABLE TERMINATION
- THREE-PHASE (MAX 400A)
2.4/4.8kV TO 16/27.6kV

Dwg. No. DU-08-202 Rev. 02







PART #		DESCRIPTION	QTY.
1	AS NEEDED	BARE COND, COPPER, AS REQ'D	A/R
2	30013881	STAPLE, GROUND WIRE, 3/8" X 1-1/2"	A/R
3	AS NEEDED	TERMINATION, COLD SHRINK, 28KV	3
4	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	A/R
5	AS NEEDED	CONNECTOR, TAP WEDGE, AMP	A/R
6	30006969	CONNECTOR, LIVE LINE, PIGTAIL WEDGE	3
7	30006856	STUD, LIVE LINE	6
8	30008425	INSULATOR, STANDOFF 28 kV	4
9	30000825	BRACKET, CUTOUT/ARRESTER	3
10	30008041	SUPPORT, CABLE & TERMINATION	3
11	30008340	TAPE, ELECTRICAL, PVC, BLACK	A/R
12	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	A/R
13	30011045	SWITCH, DISCONNECT 28KV 900A	3
14	AS NEEDED	ARRESTER, RISER POLE, AS REQ'D	3
15	AS NEEDED	BOLT, 3/4"	A/R
16	30001595	WASHER, 3/4" X 2" X 2"	A/R
17	30006184	CONNECTOR, STIRUP, BOLTED	A/R
18	30006195	CONNECTOR, LIVE LINE	A/R
19	30000770	CLAMP REST, INSULATOR TYPE	A/R
20	30020499	BOLT, DOUBLE ARMING, 3/4" X 18"	1
21	30014480	BARE COND., #4 A/R	A/R

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
150	6"
250	10"
600	2'-0"
750	2'-6"
1500	5'-0"

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 16 – MATERIALS
O/H DISTRIBUTION STANDARDS

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 10 x DIAMETER OF CABLE.
3. SLACK LOOP OF GROUND WIRE. ALL GROUNDS TO BE CONTINUOUS WHERE POSSIBLE.
4. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL.
5. DEAD END INSTALLATIONS NOT PREFERRED.
6. POSITION THE CONDUIT SO AS TO ACCOMMODATE THE NEUTRAL AND ANY JOINT USE REQUEST.
7. STANDOFF BRACKETS CAN BE USED IN AREAS WHERE NO BUCKET TRUCK ACCESSIBILITY IS AVAILABLE AND WHERE SEVERAL CABLES ON THE POLE MAKE IT DIFFICULT TO CLIMB, SEE DU-08-303.
8. ORIENT SWITCHES & BRACKETS TO SUIT LOCAL NEEDS.

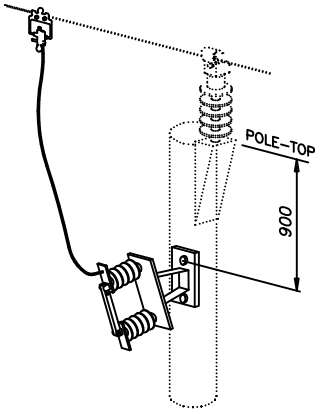
Rev. No.	Issue Date	Revision	Dwn	Approved By Date
*	* *	* *	* *	* *
*	* *	* *	* *	* *

hydro one **Hydro One Networks Inc.**

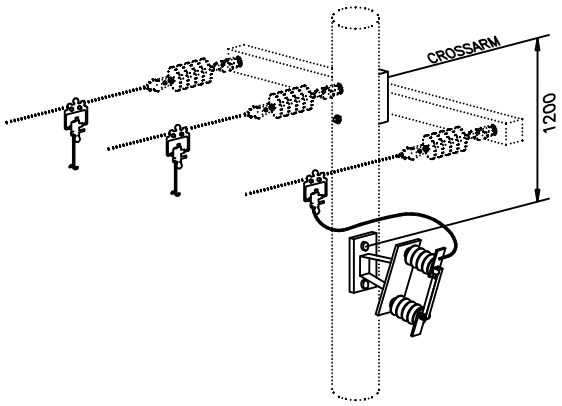
Drawn:	Approved:	Date:
G.OKLECINSKI	*	NOV. 11, 2011

SWITCHED SOLID BLADE
PRIMARY CABLE TERMINATION - THREE PHASE,
2.4/4.16kV TO 16/27.6kV (MAX 600A)

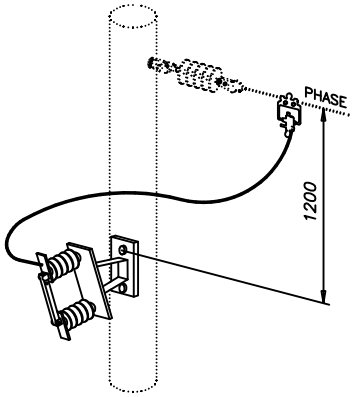
Dwg. No. DU-08-204 Rev. 00



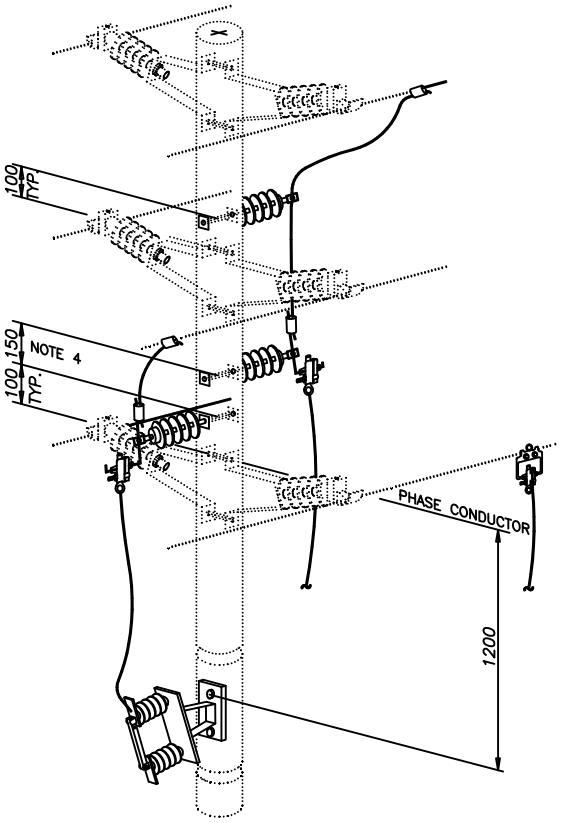
'D1'



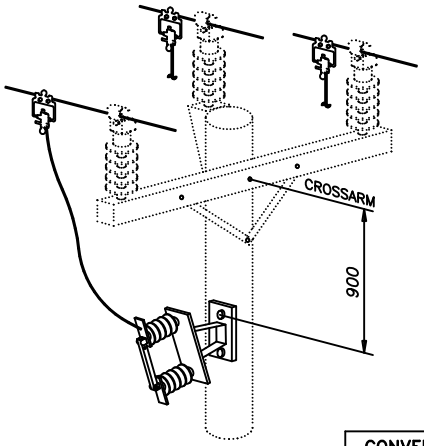
'D4'
SEE NOTE 3



'D2'
SEE NOTE 3



'D5'



'D3'

CONVERSION TABLE	
METRIC	IMPERIAL (APPROX)
100mm	4"
150mm	6"
900mm	3'
1200mm	4'
1500mm	5'

ALL DIMENSIONS ARE IN mm

REFERENCES

SECTION 1 – DEFINITION
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITION
SECTION 16 – MATERIALS LIST
O/H DISTRIBUTION STANDARDS

NOTES:
1. FRAMING DETAILS ARE ILLUSTRATIVE ONLY. SEE DU-08-208 FOR APPLICABLE FRAMINGS.
2. SWITCH ORIENTATION TO SUIT LOCAL NEEDS.
3. DEAD END INSTALLATIONS NOT PREFERRED.
4. ALTERNATIVELY USE DOUBLE ARMING BOLT AND SHARE BOLT HOLE WITH OPPOSING STANDOFF INSULATOR.

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
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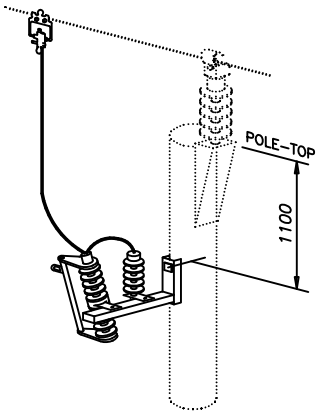
*	* *	* *	* / *	

hydro one **Hydro One Networks Inc.**

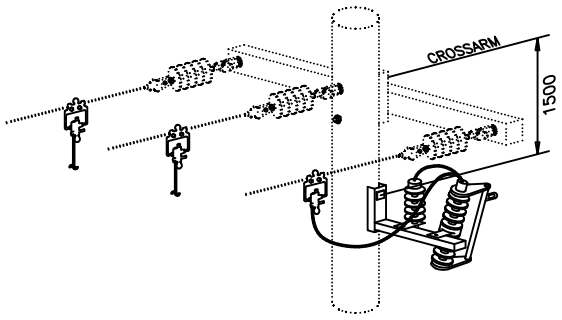
Drawn:	Approved:	Date:
P.CIARMOLI	*	NOV.11, 2011

FRAMING DIMENSIONS FOR SOLID SWITCHED O/H-U/G TRANSITIONS

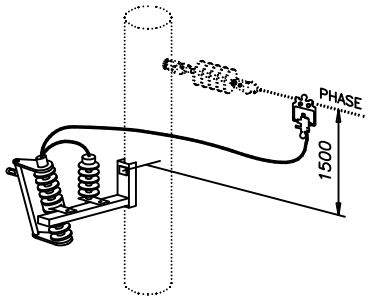
Dwg. No. DU-08-205 Rev. 00



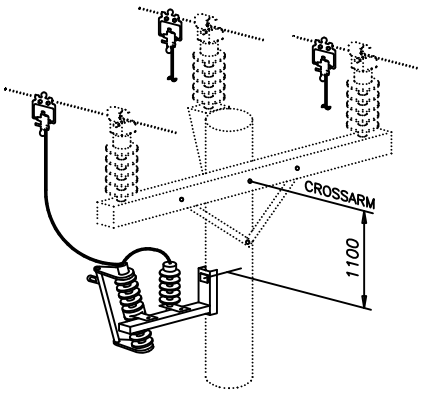
'D1'



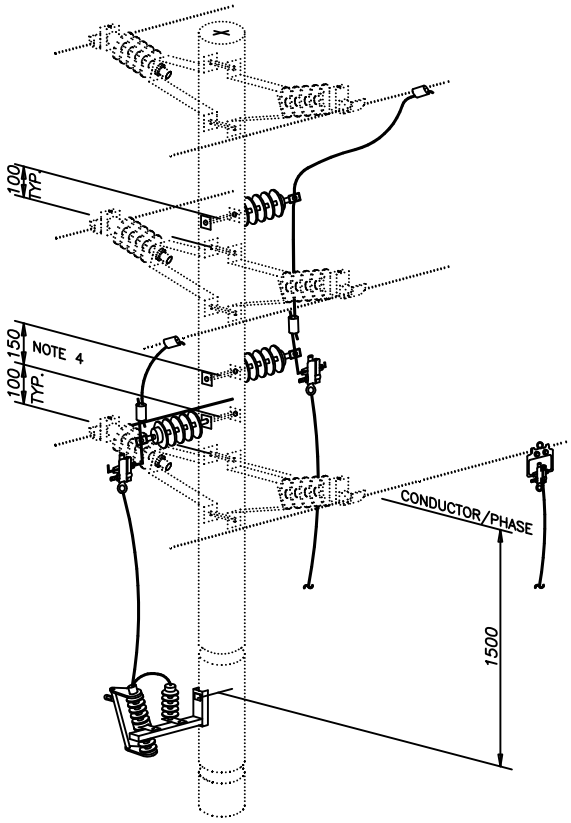
'D4'
SEE NOTE 3



'D2'
SEE NOTE 3



'D3'



'D5'

CONVERSION TABLE	
METRIC	IMPERIAL (APPROX)
100mm	4"
150mm	6"
1100mm	3'-8"
1500mm	5'

ALL DIMENSIONS ARE IN mm

REFERENCES

SECTION 1 – DEFINITION
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITION
SECTION 16 – MATERIALS LIST
O/H DISTRIBUTION STANDARDS

NOTES:
1. FRAMING DETAILS ARE ILLUSTRATIVE ONLY. SEE DU-08-208 FOR APPLICABLE FRAMINGS.
2. CUTOUT/ARRESTER BRACKET ORIENTATION TO SUIT LOCAL NEEDS.
3. DEAD END INSTALLATIONS NOT PREFERRED.
4. ALTERNATIVELY USE DOUBLE ARMING BOLT AND SHARE BOLT HOLE WITH OPPOSING STANDOFF INSULATOR.

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
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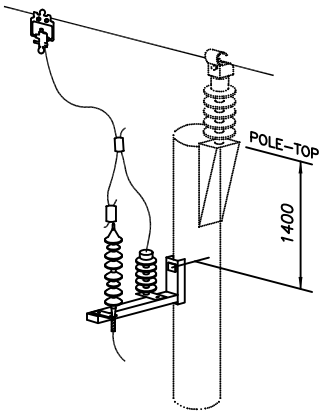
hydro one **Hydro One Networks Inc.**

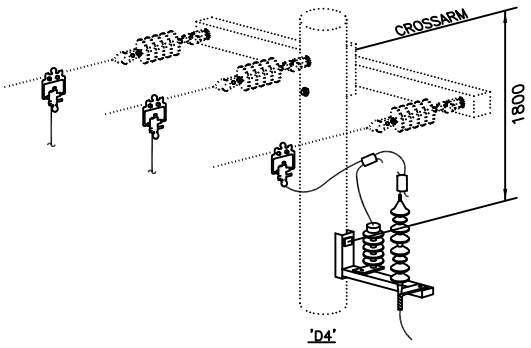
Drawn:	Approved:	Date:
P.CIARMOLI	*	NOV. 03, 2011

FRAMING DIMENSIONS WITH CUTOUTS
O/H-U/G TRANSITIONS

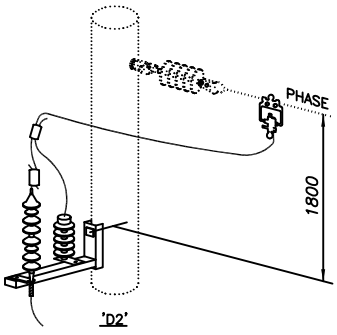
Dwg. No. DU-08-206 Rev. 00



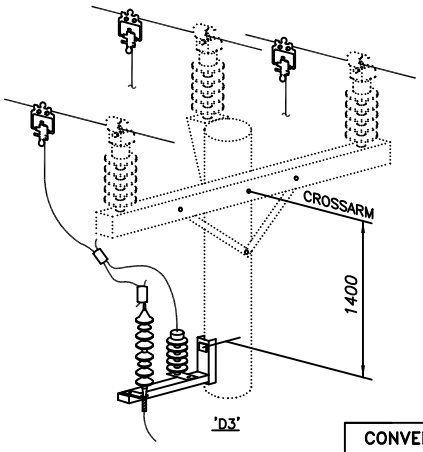
'D1'



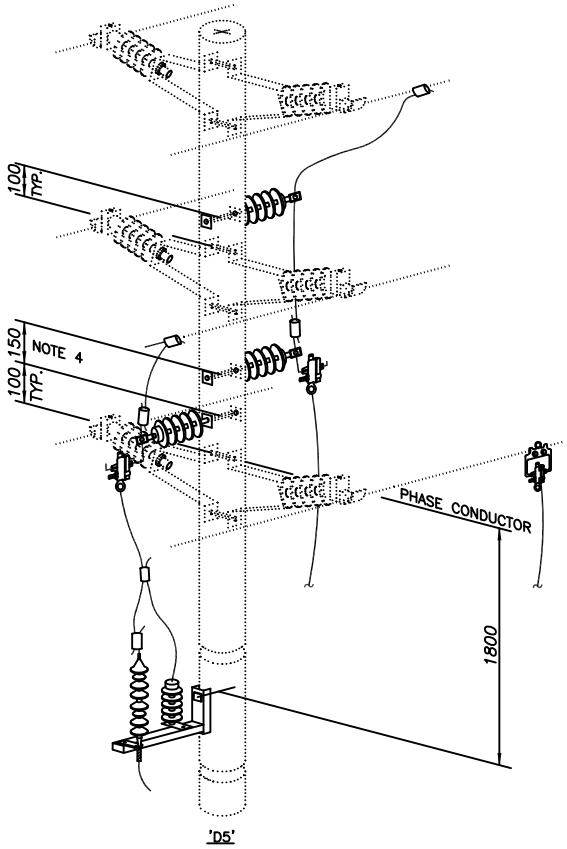
'D4'
SEE NOTE 3



'D2'
SEE NOTE 3



'D3'



'D5'

ALL DIMENSIONS ARE IN mm

REFERENCES

SECTION 1 – DEFINITION
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITION
SECTION 16 – MATERIALS LIST
O/H DISTRIBUTION STANDARDS

CONVERSION TABLE	
METRIC	IMPERIAL (APPROX)
100mm	4"
150mm	6"
1400mm	4'–8"
1800mm	6'

NOTES:
1. FRAMING DETAILS ARE ILLUSTRATIVE ONLY. SEE DU–08–208 FOR APPLICABLE FRAMINGS.
2. TERMINATION/ARRESTER BRACKET ORIENTATION TO SUIT LOCAL NEEDS.
3. DEAD END INSTALLATIONS NOT PREFERRED.
4. ALTERNATIVELY USE DOUBLE ARMING BOLT AND SHARE BOLT HOLE WITH OPPOSING STANDOFF INSULATOR.

Rev. No.	Issue Date	Revision	Dwn	Approved By
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*	* *	* *	*	*
			Chk	Date

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
P.CIARMOLI	*	NOV.11,2011

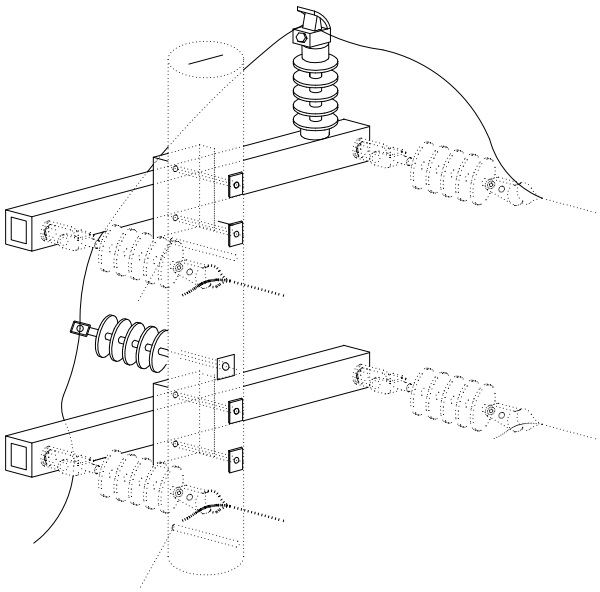
FRAMING DIMENSIONS FOR UNSWITCHED O/H-U/G TRANSITIONS

Dwg. No. DU-08-207 Rev. 00

FRAMING DRAWINGS APPLICABLE WITH DU-08-205, DU-08-206 AND DU-08-207:

D1	D2	D3	D4	D5
DL3−101.1	DL3−103	DL3−120.1	DL3−110.2	DL3−106
DL3−101.2	DL3−104	DL3−120.2	DL3−110.3	DL3−107
DL3−102.1	DL3−105	DL3−120.3		DL3−108.1
DL3−102.2		DL3−120.4		DL3−108.2
		DL3−121.1		DL3−110.1
		DL3−121.2		DL3−113
		DL3−121.3		DL3−114
		DL3−121.4		DL3−115
				DL3−116
				DL3−118.1*

*ADDITIONAL LP INSULATOR REQUIRED ON UPPERMOST CROSSARM (SEE 'FIGURE 1') TO TRAIN DROPLEAD OVER CROSSARM AND DOWN BACKSIDE OF POLE. FUTHERMORE, ENSURE PROPER APPLICATION OF INSULATED GUY RODS TO MAINTAIN ADEQUATE CLEARANCES FROM DOWN GUYS TO DROPLEAD.



'FIGURE 1'
UPPER LP INSULATOR ARRANGEMENT
FOR DL3−118.1 FRAMING

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved / By / Date
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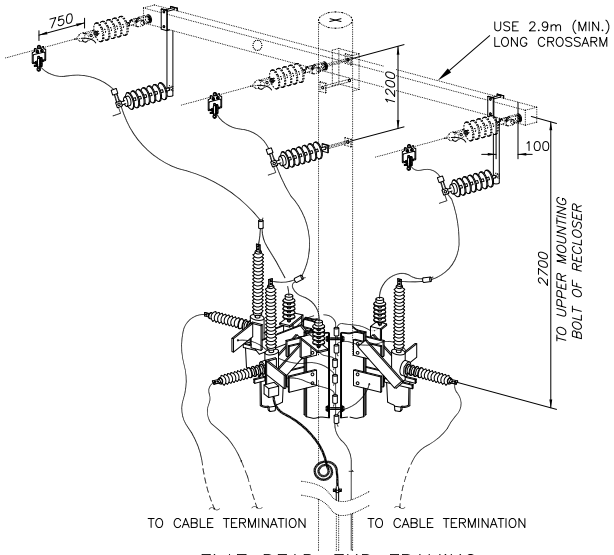
*	* *	* *	* *	*

hydro one **Hydro One Networks Inc.**

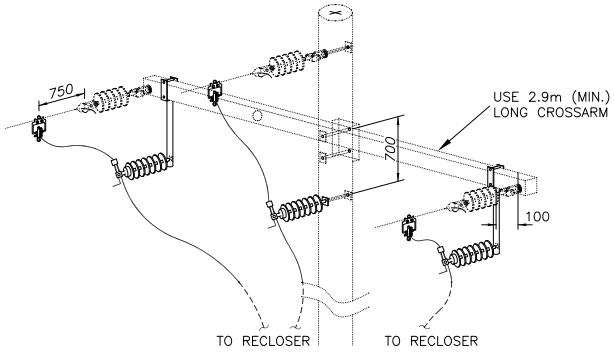
Drawn:	Approved:	Date:
G.OKLECINSKI	*	NOV. 16, 2011

APPLICABLE FRAMINGS FOR
DU-08-205, DU-08-206 AND DU-08-207

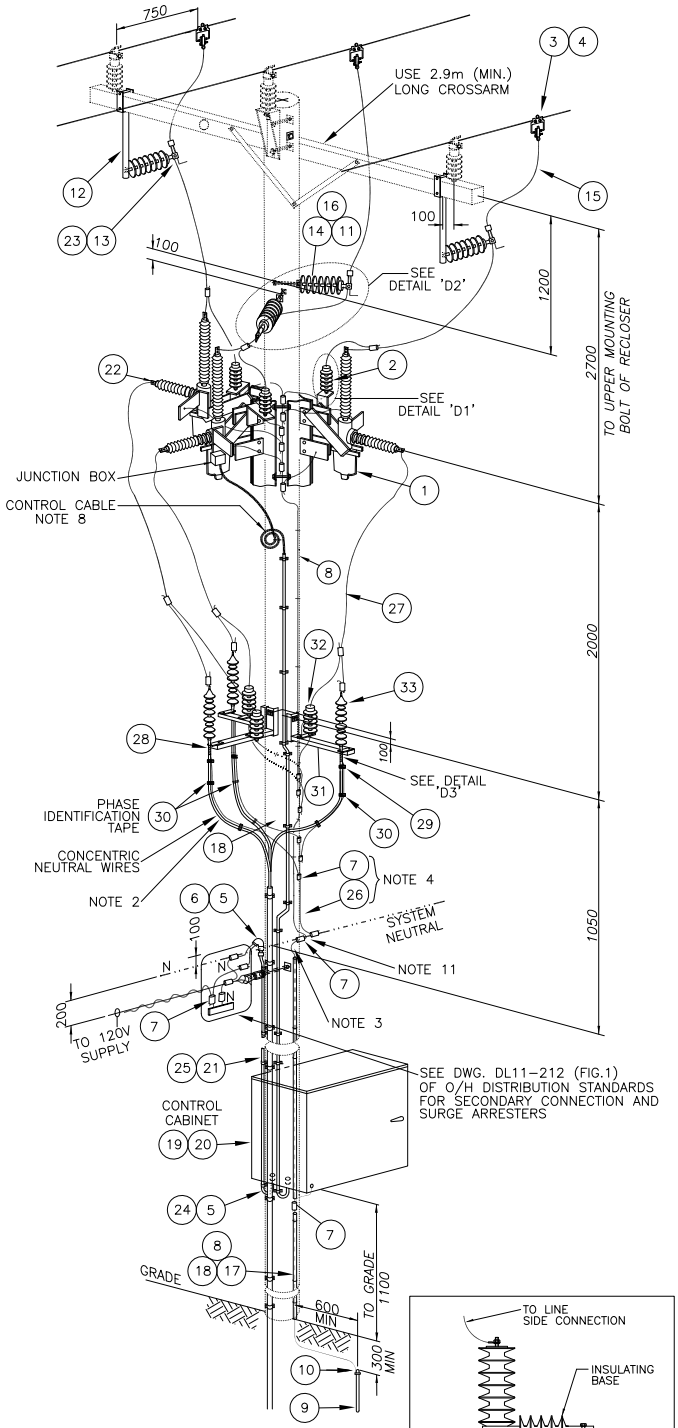
Dwg. No. DU-08-208 Rev. 00



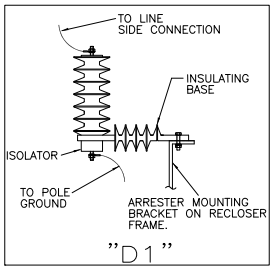
FLAT DEAD–END FRAMING



TRIANGULAR DEAD–END FRAMING



TANGENT FRAMING



NOTES

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE
2. MINIMUM BENDING RADIUS 10X DIAMETER OF CABLE
3. SLACK LOOP OF GROUND WIRE
4. EXTRA LENGTH OF 1/0 CONDUCTOR NOT REQUIRED IF CONCENTRIC NEUTRAL WIRES ARE OF SUFFICIENT LENGTH TO DIRECTLY CONNECT TO THE SYSTEM NEUTRAL
5. KEEP CONTROL CABLE AS FAR AWAY AS POSSIBLE FROM ARRESTER GROUND WIRE.
6. SEE MFG. REFERENCE DWG'S INSTRUCTIONS FOR INSTALLING RECLOSER, RECLOSER FRAME, AND CONTROL BOX.
7. MECHANICALLY PROTECT AND SECURE CONTROL CABLE & ITS CONNECTORS AS REQUIRED BY SAFETY CODE.
8. LOOP EXCESS CONTROL CABLE AND ATTACH TO POLE NEAR RECLOSER MOUNTING FRAME.
9. PROPERLY SECURE ARRESTER GROUND WIRE TO PREVENT IT FROM CONTACTING ENERGIZED CONDUCTOR/CABLE IN THE EVENT OF OPERATION OF ARRESTER DISCONNECTOR.
10. SURGE ARRESTER AND RECLOSER TO MATCH SYSTEM VOLTAGE. CABLE TERMINATION TO MATCH CABLE VOLTAGE RATING AND CONDUCTOR SIZE. 38kV RECLOSER FOR 27.6kV SYSTEM AND 27kV RECLOSER FOR LESS THAN 27.6kV SYSTEMS.
11. FOR DEAD–END FRAMING, MAKE POLE GROUND CONNECTION AND CABLE CONCENTRIC NEUTRAL CONNECTION TO THE DEAD–ENDED SIDE OF PRIMARY NEUTRAL.
12. SET RECLOSER TO ONE–SHOT LOCKOUT.
13. RECLOSER ASSEMBLY WEIGHT – 227KG (500LBS)
    CONTROL BOX – 70KG (150LBS)

REFERENCES
SECTION 1 – DEFINITIONS
SECTION 4C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 16 – MATERIALS LIST

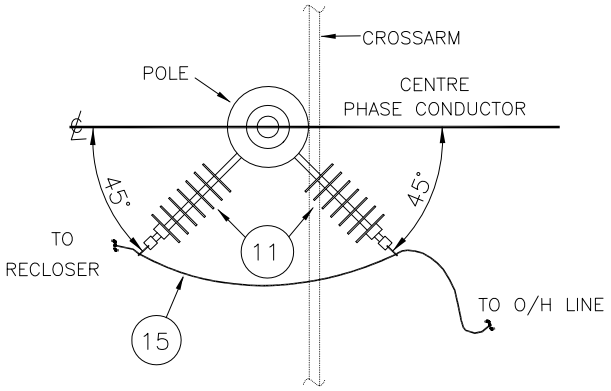
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
*	* *	* *	* *	* *

hydro one **Hydro One Networks Inc.**

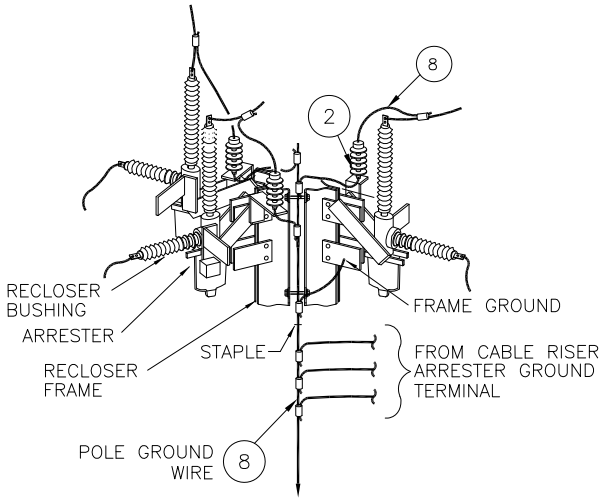
Drawn:	Approved:	Date:
W. BURDEN	D. PARIKH	NOV.15,2011

RECLOSER CONNECTED O/H TO U/G CABLE RISER UP TO 28kV, 3 PHASE (G&W VIPER)

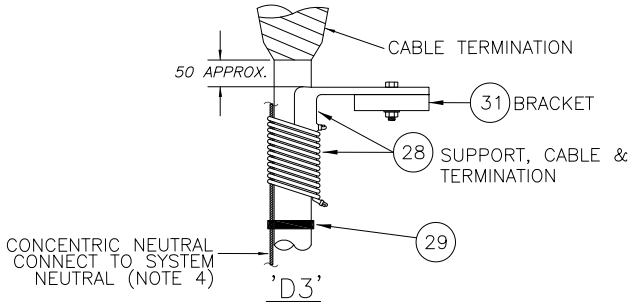
Dwg. No. DU-08-209 - SHT. 1 OF 3 Rev. 00



'D2'



RECLOSER FRAME AND
S.A. GROUNDING DETAILS



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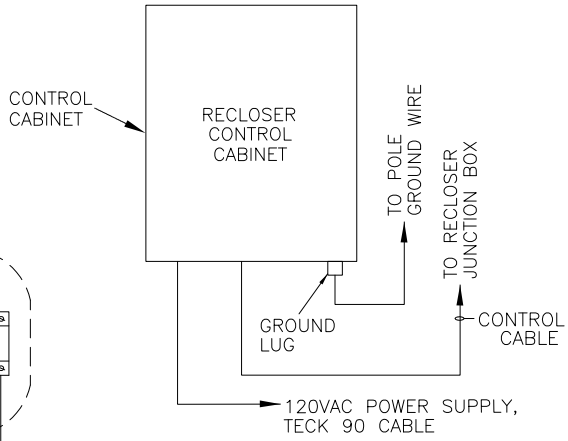
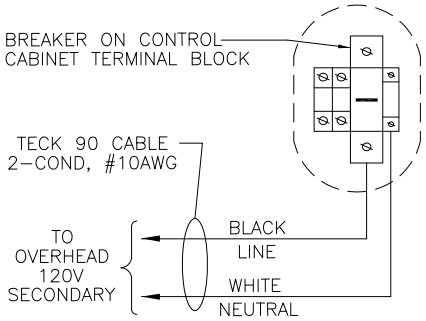
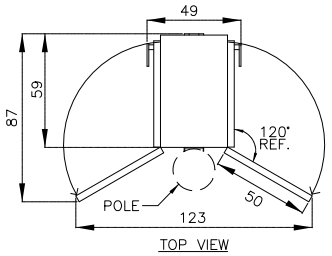
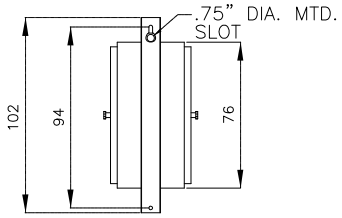


3-PHASE
CONTROL CABINET

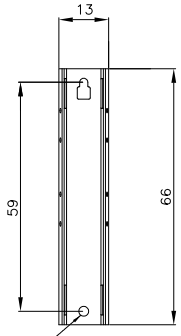




CONTROL CABINET



BACK VIEW



RECLOSER MOUNTING
BRACKET DETAILS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
*	* *	* *	* *	* *

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	*	NOV.15,2011

RECLOSER CONNECTED O/H TO U/G CABLE RISER
UP TO 28kV, 3 PHASE (G&W VIPER)

Dwg. No. DU-08-209 - SHT. 2 OF 3 Rev. 00

PARTS LIST			
PART#	MM#	DESCRIPTION	QTY
(1)	10011324 10011325	RECLOSER, 3 PHASE CLUSTER MOUNT, COMPLETE WITH FRAME, CONTROL CABINET, AND SLEVE G&W VIPER SP–38/27kV MAX	1
(2)	AS NEEDED	ARRESTER, SURGE	6
(3)	30006968	STIRRUP, BOLTED	3
(4)	30007392	LIVE LINE CONNECTOR	3
(5)	30007902	CONNECTOR, AL, TECK 90, 10/2 CABLE 1/2" HUB	2
(6)	30020497	BODY CONDUIT ALUM, F–TYPE, 1/2", THREADED (WEATHER HEAD)	1
(7)	AS NEEDED	CONNECTOR, WEDGE TAP	20
(8)	30005813	CONDUCTOR, BARE CU, #4 AWG	–
(9)	30014142	ROD, GROUND, 3/4"x10' GALV	1 (MIN)
(10)	30006646	CONNECTOR GROUND ROD	1 (MIN)
(11)	30008425	STANDOFF INSULATOR	3 (MIN)
(12)	30000952	T–TYPE STANDOFF BRACKET	2
(13)	30000770	CLAMP REST	3
(14)	AS NEEDED	BOLT, 3/4"	16 (MIN)
(15)	30005826	CONDUCTOR, BARE CU, 4/0, SD	–
(16)	30001595	WASHER, 3/4"x2"x2"	17
(17)	30000053	GUARD, GROUNDING WIRE, WOOD	–
(18)	AS NEEDED	STAPLE	–
(19)	AS NEEDED	BOLT, 5/8"	2
(20)	30001594	WASHER, SQUARE, 5/8x2"x2"	2
(21)	30006055	CABLE, TECK 90, 10/2	9m (MIN)
(22)	30006460	CONNECTOR, TERMINAL, COMPRESSION, 4/0	6
(23)	30000355	CONNECTOR, WEDGE TAP, 2/0–4/0	3
(24)	30020496	GROUND BUSHING, 1/2", CONDUIT	1
(25)	30007508	CLAMP, CONDUIT, 3/4"	–
(26)	30005821	CONDUCTOR, BARE CU, 1/0, 7 STRAND, MHD	*
(27)	30005825	CONDUCTOR, BARE CU, 4/0 AWG, MHD	–
(28)	30008041	SUPPORT, CABLE & TERMINATION	3
(29)	30008340	TAPE, ELECTRICAL, PVC, BLACK	*
(30)	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME––WHITE SAME––BLUE	*
(31)	30000825	BRACKET, CUTOUT/ARRESTER	3
(32)	AS NEEDED	ARRESTER, RISER POLE	3
(33)	AS NEEDED	TERMINATION, COLD SHRINK, 28 kV	3

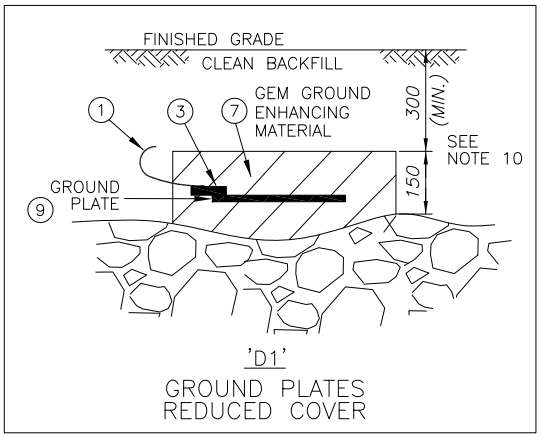
Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
*	* *	* *	* *	* *

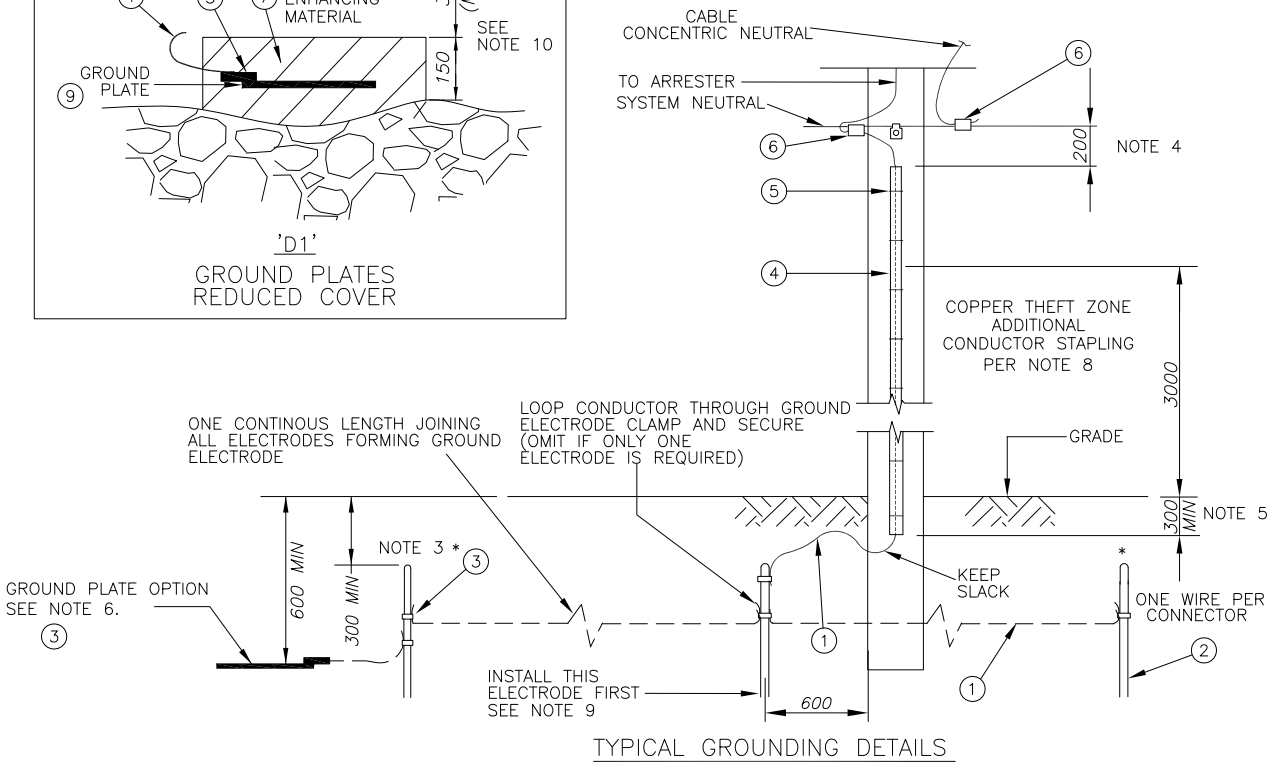
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	D. PARIKH	NOV.15,2011

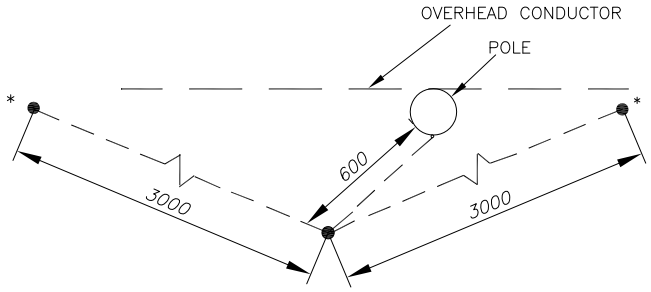
RECLOSER CONNECTED O/H TO U/G CABLE RISER UP TO 28kV, 3 PHASE (G&W VIPER)

Dwg. No. DU-08-209 - SHT. 3 OF 3 Rev. 00





TYPICAL GROUNDING DETAILS



CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
200	8"
300	1'–0"
600	2'–0"
3000	10'–0"

REFERENCES:
SECTION 1 DEFINITIONS
SECTION 6C CONSTRUCTION GUIDE
SECTION 16 MATERIALS LIST

PART #	MM #	DESCRIPTION	QTY.
①	30014480	BARE COND, COPPER, 4AWG	
②	30014142	ROD, GROUND, 3/4" x 10ft, GALVANIZED	1(MIN)
③	30006646	CONNECTOR, GROUND ROD	1(MIN)
④	30000053	MOULDING, GROUND WIRE	AS REQD
⑤	30001753	STAPLE 3", MOULDING	AS REQD
⑥	AS REQD	CONNECTOR, TAP WEDGE	AS REQD
⑦	30025402	GEM. MATERIAL	AS REQD
⑧	30013881	STAPLE, GROUND WIRE	NOTE 8
⑨	30025401	GRD. PLATE, GALVANIZED	AS REQD

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. DO NOT INSTALL THE GROUND ELECTRODE CONNECTOR ON THE TAPERED SECTION OF THE GROUND ELECTRODE.
3. ADDITIONAL GROUNDING (*) IF MAIN GROUND RESISTANCE > 25 ohms. ADDITIONAL NUMBER OF ELECTRODES DOES NOT EXCEED TWO.
4. ON JOINT USE POLES, THE WIRE GUARD SHALL EXTEND TO AT LEAST 1.0 m ABOVE COMMUNICATION PLANT OR 200 mm BELOW NEUTRAL, WHICHEVER IS HIGHER.
5. INCREASE DEPTH TO 500 mm IN CULTIVATED LAND.
6. GROUND PLATES TO BE INSTALLED ONLY IF GROUND RODS CANNOT BE DRIVEN DUE TO ROCKY GROUND.
7. FOR ADDITIONAL DETAILS REFER TO OVERHEAD DISTRIBUTION STANDARDS–SECTION 12
8. STAPLE CONDUCTOR EVERY 15cm TO 3M ABOVE GRADE BEFORE INSTALLING THE WOOD MOULDING. 50cm TYP. ELSEWHERE.
9. IN ROCKY/POOR SOIL CONDITIONS THE FIRST ELECTRODE MAY BE INSTALLED BENEATH THE POLE PER DL12–302.
10. MECHANICAL PROTECTION (75mm 21 MPa CONCRETE) IS REQUIRED OVER PLATES AND GROUND WIRES FOR BURIAL DEPTHS LESS THAN 300mm.

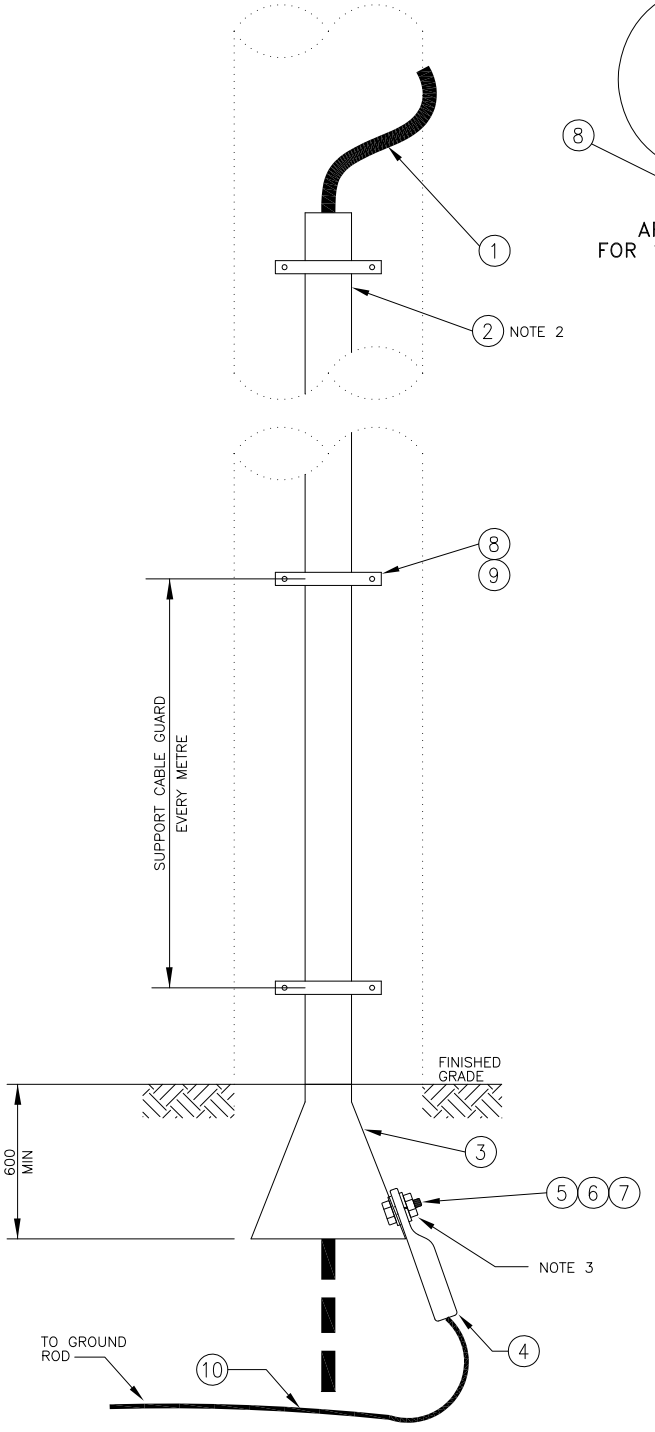
Rev. No.	Issue Date	Revision	Dwn	Chk	Approved By	Date
03	OCT 2011	DELETE METAL GUARD ADDED PLATE OPTION	PC *			

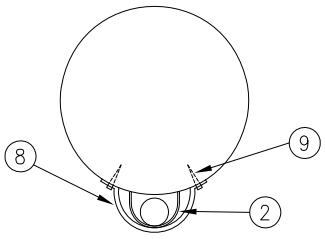
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
P.CIARMOLI	*	OCT.14,2011

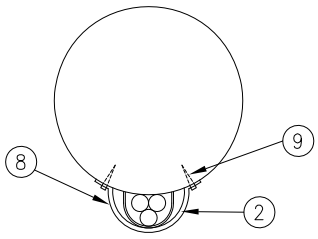
GROUNDING DETAILS AT
PRIMARY RISER/DIP POLE - TYPICAL

Dwg. No. DU-08-301 Rev. 03

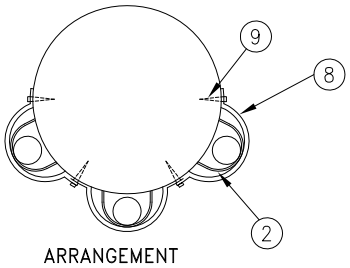




ARRANGEMENT
FOR 1 CABLE GUARD



ARRANGEMENT
FOR 3–CABLES UNDER THE SAME GUARD



ARRANGEMENT
FOR 3 SEPARATE CABLE GUARDS

PART #	MASTER MATERIAL #	DESCRIPTION	QTY.
1	30010134 30006080	28kV CABLE – 2/0 – 350kcmil	
2	30000733 30000732 30000897	A– GUARD, CABLE, 60mm x 2.4m, AL OR GALVANIZED STEEL B– GUARD, CABLE, 80mm x 2.4m, AL OR GALVANIZED STEEL C– GUARD, CABLE, 100mm x 2.4m, AL OR GALVANIZED STEEL	AS REQ'D
3	30023782 30023781 30024858	A1– FLARED GUARD, CABLE, 58mm x 2.4m B1– FLARED GUARD, CABLE, 82.5mm x 2.4m C1– FLARED GUARD, CABLE, 108mm x 2.4m	1 min.
4	30024855	COMPRESSION LUG, COPPER, STANDARD BODY, #4 AWG	1
5	30001137	BOLT, HEX HEAD, GR2 – 12.7mm – 38.1mm LG – GALV. c/w NUT	1
6	30001591	WASHER, ROUND, 14.3mm, GALV.	1
7	30001605	WASHER, LOCK, HELICAL SPRING, 12.7mm BOLT	1
8	30000744 30000746 30000923	D– STRAP, CABLE, 60mm, AL OR GALVANIZED STEEL E– STRAP, CABLE, 80mm, AL OR GALVANIZED STEEL F– STRAP, CABLE, 100mm, AL OR GALVANIZED STEEL	3 min.
9	30001989	BOLT, LAG, HEX HD, GALV. 1/4" DIA., 2–1/2" LG	6 min.
10	30014480	BARE COND. COPPER #4 AWG	

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 16 – MATERIALS

CABLE		1–CABLE UNDER GUARD		3–CABLES UNDER GUARD	
SIZE	kV	GUARD	STRAP	GUARD	STRAP
2/0	28	A/A1	D	B/B1	E
350 KCMIL	28	A/A1	D	C/C1	F

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. CABLE GUARD SHALL BE EXTENDED TO PROVIDE PROTECTION OF ENTIRE LENGTH OF CABLE(S) ON THE POLE AND SHALL BE GROUNDED AS SHOWN IN DU–03–213.
3. BOLT IS TO BE INSTALLED WITH HEAD ON INTERIOR SURFACE OF FLARED GUARD.

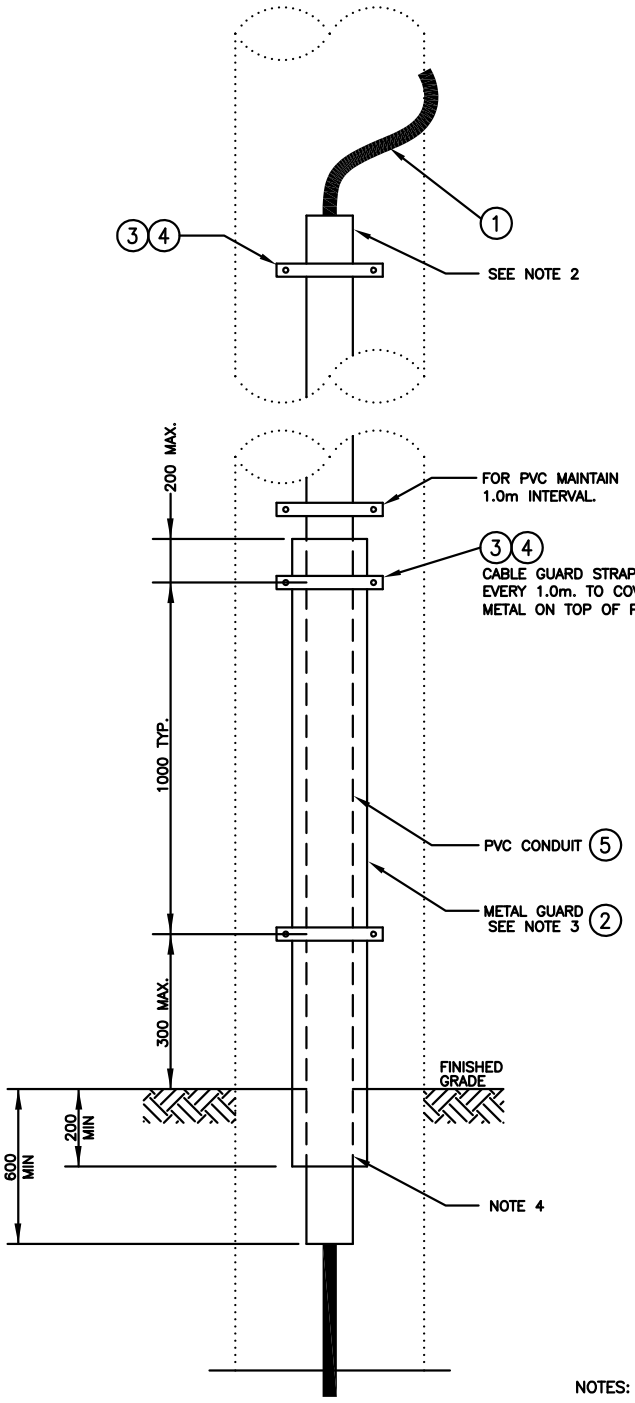
Rev. No.	Issue Date	Revision	Dwn	Approved By / Date
*	* *	* *	* / *	
02	JULY 2009	ADDITION OF FLARED CABLE GUARD & REMOVAL OF CAD WELD	PC / *	

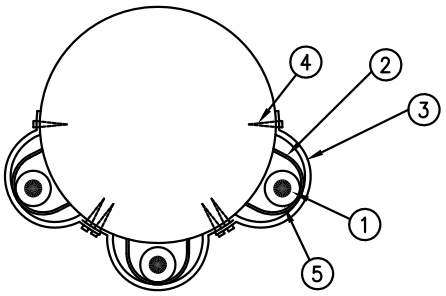
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
P.CIARMOLI	*	JULY.22,2009

CABLE GUARD APPLICATION - WOOD POLES

Dwg. No. DU-08-302 Rev. 02





ARRANGEMENT
FOR 3 SEPARATE CABLE GUARDS

PART #	MASTER MATERIAL #	DESCRIPTION	QTY.
1	30010134	28kV CABLE – 2/0, AL	AS REQ.'D
2	30000733	GUARD, CABLE, 60mm x 2.4m GALVANIZED STEEL	1 MIN.
3	30000744	STRAP, CABLE, 60mm, GALVANIZED STEEL	AS REQ.'D
4	30001989	BOLT, LAG, HEX HD, GALV. 1/4" DIA 2-1/2" LG	AS REQ.'D
5	30007542	CONDUIT, SCHEDULE 40 CONDUIT, RIGID PVC, 53mm	AS REQ.'D

CONVERSION TABLE	
METRIC (MM)	IMPERIAL (APPROX)
200	8"
300	1'–0"
600	2'–0"
1000	3'–3"

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 16 – MATERIALS

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. PVC CONDUIT SHALL BE EXTENDED TO PROVIDE PROTECTION OF ENTIRE LENGTH OF CABLE(S) ON THE POLE
3. ONE LENGTH OF METAL GUARD SHALL BE INSTALLED AT THE BOTTOM AS SHOWN.
4. METAL GUARD DOES NOT REQUIRE GROUNDING WHEN INSTALLED OVER PVC CONDUIT AS SPECIFIED.

Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
*	* *	* *	* /			
01	FEB 2012	SUBSTITUTION OF FULL LENGTH METALLIC GUARD WITH PVC CONDUIT AND ONE LENGTH OF METALLIC GUARD	*	PC		

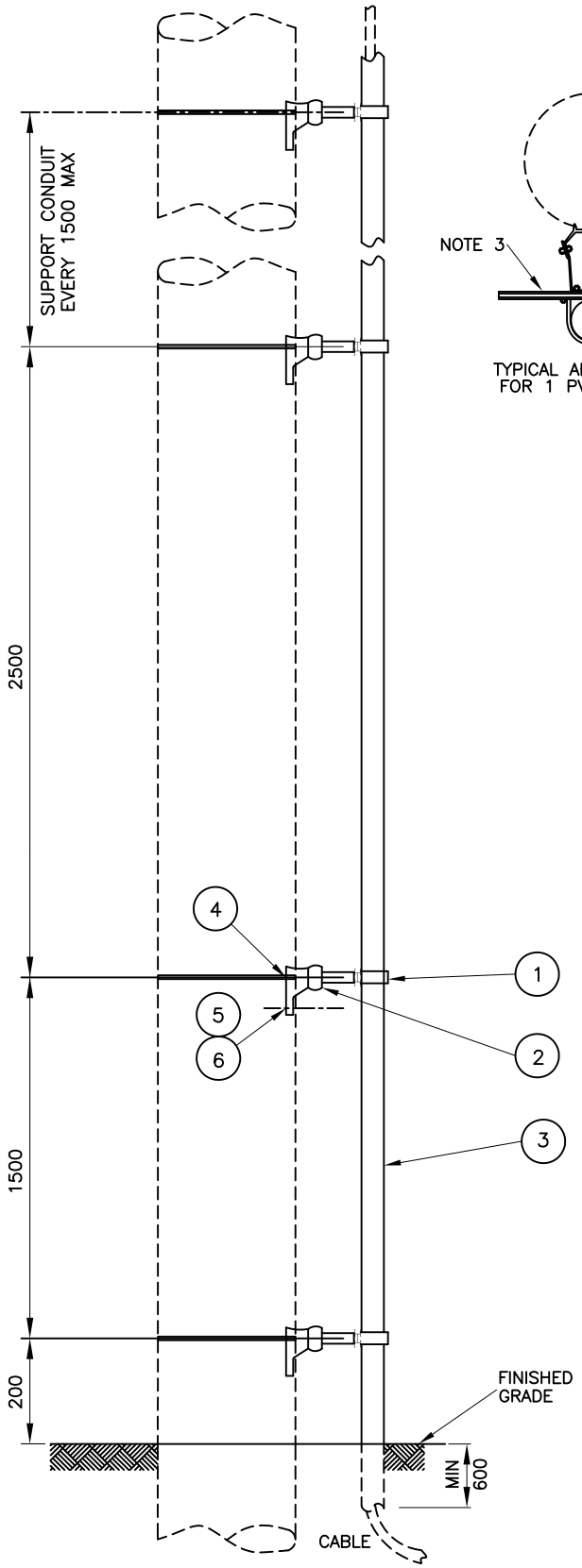
hydro one **Hydro One Networks Inc.**

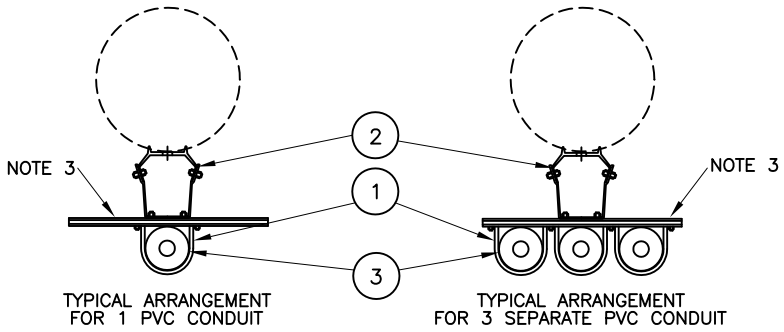
Drawn:	Approved:	Date:
P.CIARMOLI	*	AUG.30,2011

CABLE GUARD APPLICATION -
WOOD POLES - PRIMARY CABLE 2/0 AND SMALLER -
TRANSITION TO DIRECT BURIED

Dwg. No. DU-08-302.1 Rev. 01

350–xxxx.dwg 2011/8/30





PART#	MM#	DESCRIPTION	QTY.
①	AS NEEDED	STRAPS FOR CONDUIT BRACKETS AS REQ'D.	A/R
②	AS NEEDED	BRACKET, CONDUIT, STANDOFF, AS REQ'D	A/R
③	AS NEEDED	CONDUIT, PVC, BELL END, 10' LG., RIGID, AS REQ'D	A/R
④	AS NEEDED	BOLT, HEX HEAD, 5/8"	1/ BRKT
⑤	30001594	WASHER, 5/8" x 2" x 2"	1/ BRKT
⑥	30001237	1/2" BY 4" LAG BOLT	1/ BRKT

A/R = AS REQUIRED

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
200	8"
300	1'–0"
600	2"
1500	5'–0"
2500	8'–4"

NOTES:

1. STANDOFF BRACKETS CAN BE USED IN AREAS WHERE NO BUCKET TRUCK ACCESSIBILITY IS AVAILABLE AND WHERE SEVERAL CABLES ON THE POLE MAKE IT DIFFICULT TO CLIMB. OTHERWISE USE DU–08–302.
2. MINIMUM BENDING RADIUS IS TO BE 10 X THE DIAMETER OF THE CABLE.
3. JOINT USE PARTNERS TO BE POSITIONED ON BACK OF CHANNEL.
4. NOT TO BE INSTALLED NEAR PLAYGROUNDS OR SCHOOLYARDS WITHOUT ADDITIONAL WARNINGS OR BARRIERS.

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 6C – CONSTRUCTION GUIDE
SECTION 16 – MATERIALS LIST
O/H DISTRIBUTION STANDARDS

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
*	* *	* *	* / *	
1	OCT 2011	BURIAL DEPTH INCREASED MM# ADDED & GENERAL REVISIONS	WB / PC	

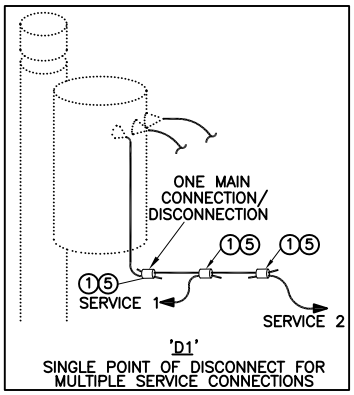
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	*	NOV.11, 2011

STANDOFF BRACKET INSTALLATION DETAILS

Dwg. No. DU-08-303 Rev. 01

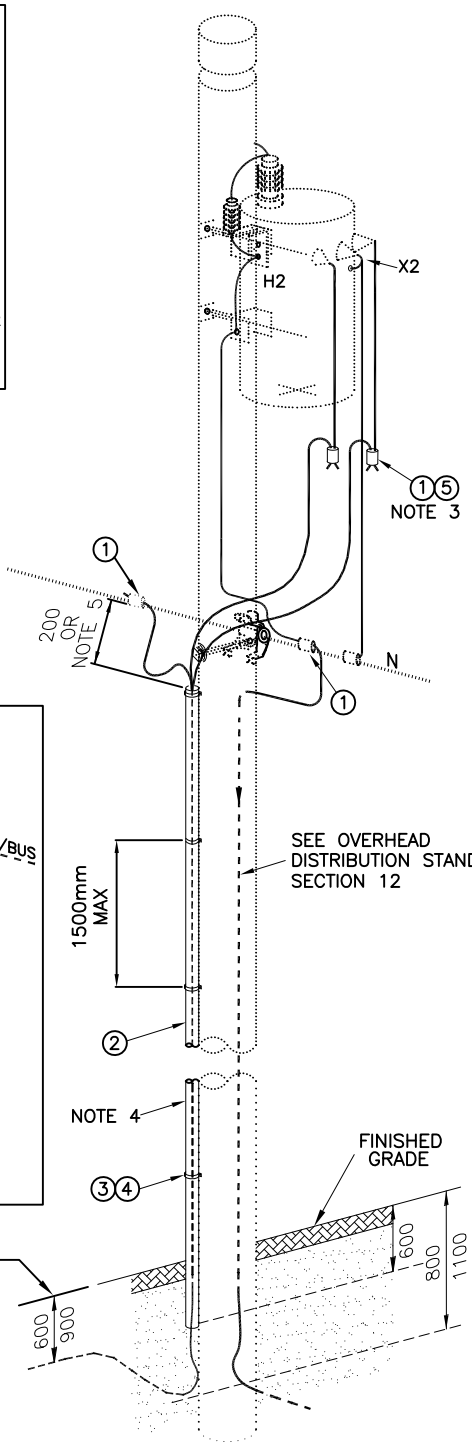
SEE OVERHEAD DISTRIBUTION STANDARDS SECTION 9 TRANSFORMERS

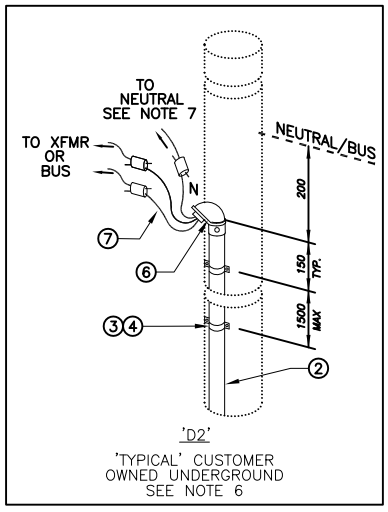


'D1'
SINGLE POINT OF DISCONNECT FOR MULTIPLE SERVICE CONNECTIONS

NOTE:

1. ITEM 2 SIZED TO SECONDARY CONDUCTOR REQUIREMENTS
2. DEPTH OF BURIAL IS MIN. 600mm PRIVATE PROPERTY OR 900mm ON ROAD ALLOWANCE. ROAD AUTHORITY APPROVAL REQUIRED WHEN TRENCHING ON ROAD ALLOWANCE
3. CONNECTIONS TO BE MADE BELOW TRANSFORMER TANK. FOR MULTIPLE SERVICES OFF ONE TRANSFORMER ENSURE A SINGLE POINT OF CONNECTION/DISCONNECTION AS PER 'D1'.
4. STANDOFF BRACKETS CAN BE USED IF THE POLE HAS NO VEHICULAR ACCESS. SEE DU-08-303
5. FORM DRIP LOOPS CONDUIT CAN BE RUN UP TO HEIGHT OF THE NEUTRAL IF DESIRED.
6. DETAIL 'D2' REPRESENTS A TYPICAL CUSTOMER INSTALLATION ONLY. CUSTOMER INSTALLATIONS MUST BE BUILT AS PER THE ONTARIO ELECTRICAL CODE AND INSPECTED BY THE ELECTRICAL SAFETY AUTHORITY. ALL PARTS SPECIFIED IN THE DETAIL ARE TO BE SUPPLIED BY THE CONTRACTOR.
7. CONNECTION TO NEUTRAL, BUS, OR TRANSFORMER TO BE MADE BY HYDRO ONE.





'D2'
'TYPICAL' CUSTOMER OWNED UNDERGROUND SEE NOTE 6

CONVERSION TABLE	
METRIC (MM)	IMPERIAL (APPROX)
200	8"
600	2'-0"
800	2'-8"
900	3'-0"
1100	3'-8"
1500	5'-0"

PART #	MM #	DESCRIPTION	QTY.
1	AS NEEDED	CONNECTOR, TAP	5
2	AS NEEDED	CONDUIT, PVC, RIGID	A/R
3	AS NEEDED	CLAMP	A/R
4	AS NEEDED	BOLT, LAG	A/R
5	AS NEEDED	COVER FOR CONNECTOR	2
6	AS NEEDED	WEATHERHEAD	SUPPLIED BY CONTRACTOR
7	AS NEEDED	UNDERGROUND CONDUCTOR	SUPPLIED BY CONTRACTOR
	A/R = AS REQUIRED		

ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 16 – MATERIALS
O/H DISTRIBUTION STANDARDS

Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
03	NOV 2011	REVISED 'D2'. ADDED NOTE 7. INCORPORATED DU-08-403	SO	*	PC	*
02	MAR. 2011	MOVED SEC. CONNECTIONS ADDED D1 & NOTES 3,4,5 & 6				
01	JUNE 2009	GUY POSITION REMOVED *	PC	*	*	*

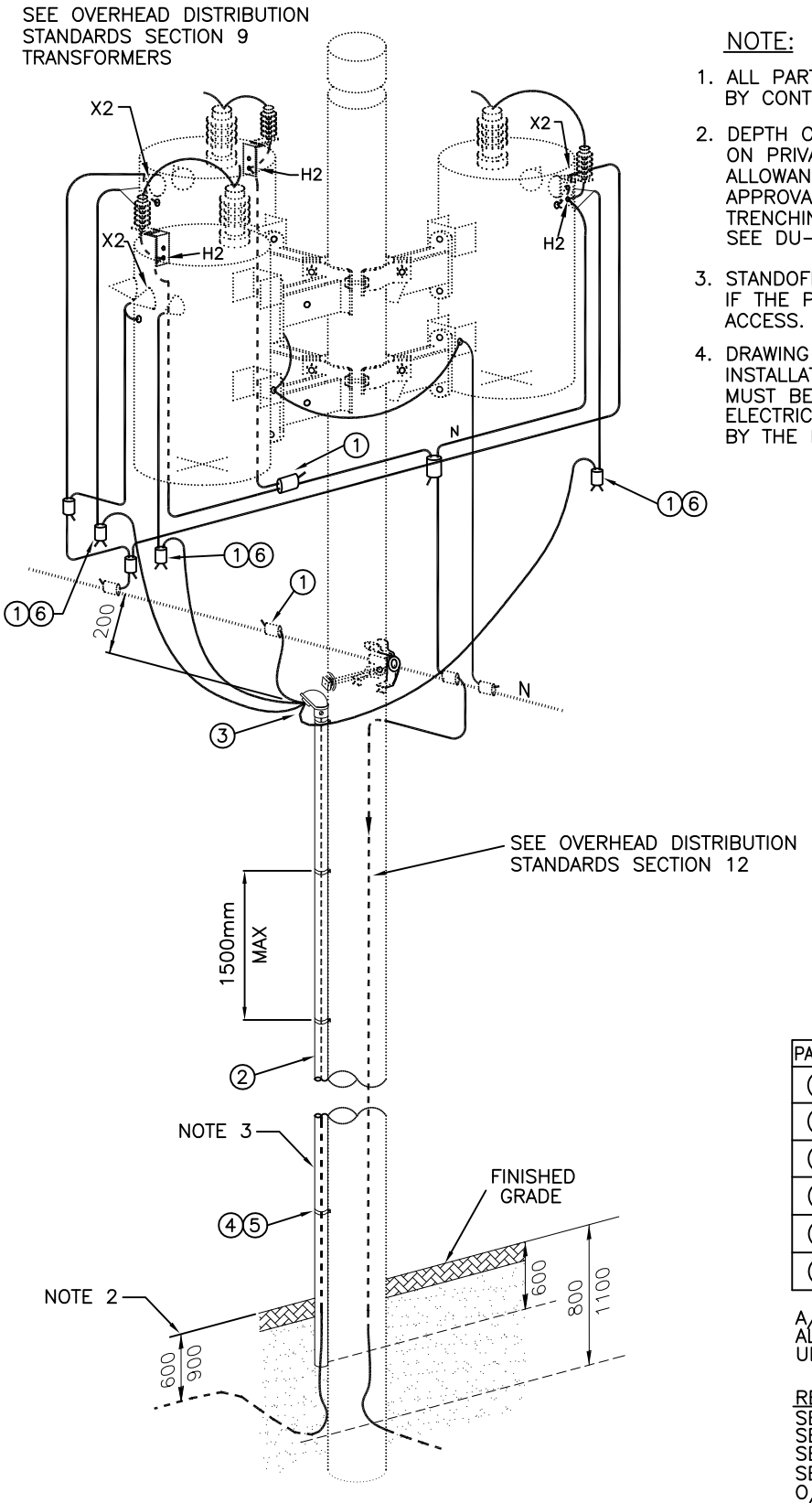
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV.16,2011

INSTALLATION OF 1Ø UNDERGROUND SECONDARY ON O/H TRANSFORMER POLE

Dwg. No. DU-08-401 Rev. 03

2011/11/16



NOTE:

1. ALL PARTS OTHER THAN # 1 & 6 SUPPLIED BY CONTRACTOR.
2. DEPTH OF BURIAL IS MIN. 600mm ON PRIVATE PROPERTY OR 900mm ON ROAD ALLOWANCE. ROAD AUTHORITY APPROVAL REQUIRED WHEN TRENCHING ON ROAD ALLOWANCE. SEE DU-03-209
3. STANDOFF BRACKETS CAN BE USED IF THE POLE HAS NO VEHICULAR ACCESS. SEE DU-08-303
4. DRAWING REPRESENTS A TYPICAL CUSTOMER INSTALLATION ONLY. CUSTOMER INSTALLATIONS MUST BE BUILT AS PER THE ONTARIO ELECTRICAL CODE AND INSPECTED BY THE ELECTRICAL SAFETY AUTHORITY.

CONVERSION TABLE	
METRIC (MM)	IMPERIAL (APPROX)
200	8"
600	2'-0"
800	2'-8"
900	3'-0"
1100	3'-8"
1500	5'-0"

PART #	MM #	DESCRIPTION	QTY.
1	AS NEEDED	CONNECTOR, TAP	A/R
2	AS NEEDED	CONDUIT, PVC, RIGID	A/R
3	AS NEEDED	WEATHERHEAD	1
4	AS NEEDED	CLAMP	7
5	AS NEEDED	BOLT, LAG	A/R
6	AS NEEDED	COVER FOR CONNECTOR	3

A/R = AS REQUIRED
ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 16 – MATERIALS
O/H DISTRIBUTION STANDARDS

Rev. No.	Issue Date	Revision	Dwn	Approved By	Date
02	NOV 2011	GENERAL REVISIONS, MODIFIED NOTES, INCORPORATED DU-08-404	WB	PC	
01	FEB 2011	GENERAL REVISION *	PC	*	*

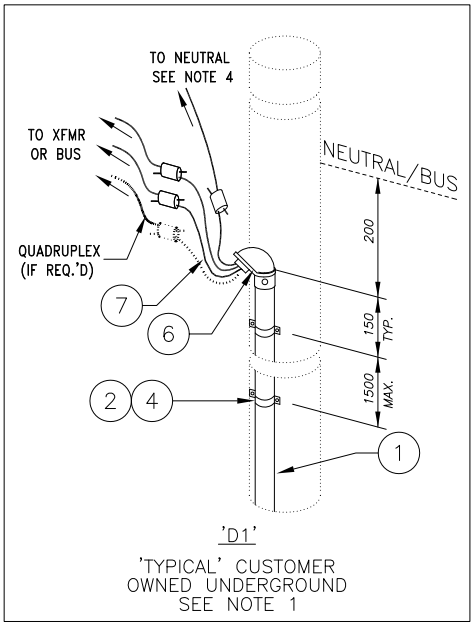
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
W. BURDEN	*	NOV. 15, 2011

INSTALLATION OF CUSTOMER OWNED 3Ø UNDERGROUND SECONDARY ON O/H TRANSFORMER

Dwg. No. DU-08-402 Rev. 02

2011/11/15



'D1'

'TYPICAL' CUSTOMER
OWNED UNDERGROUND
SEE NOTE 1

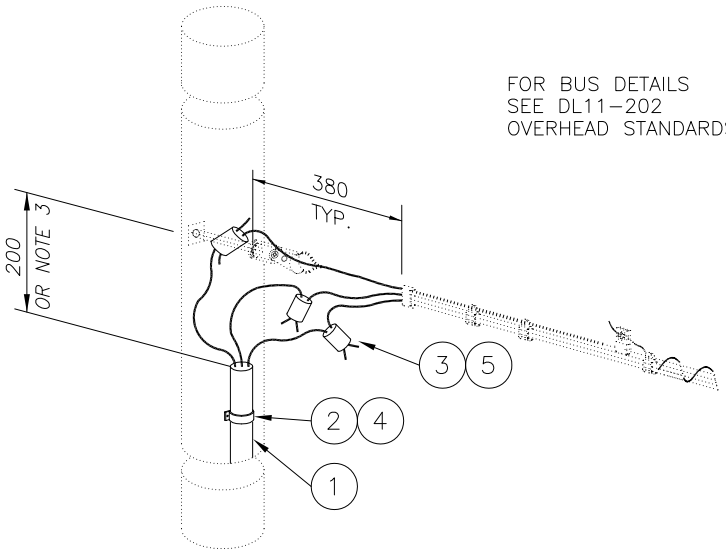
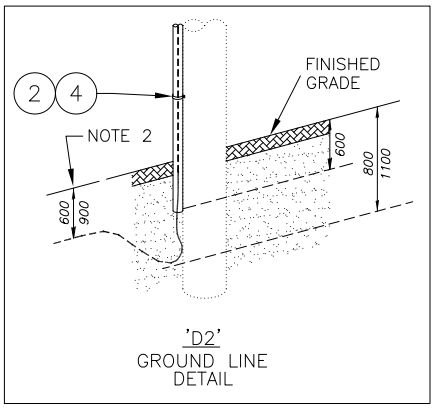


FIG.1
DEAD END



'D2'
GROUND LINE
DETAIL

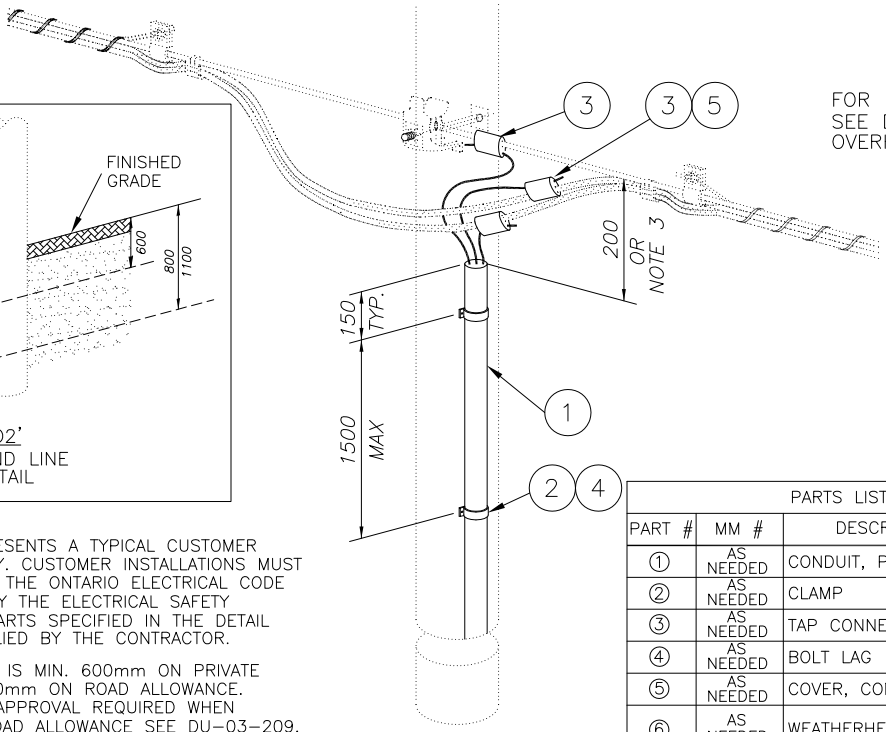


FIG.2

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
150	6"
200	8"
380	15"
600	2'-0"
800	2'-8"
1100	3'-8"
1500	5'-0"

NOTE:

1. DETAIL 'D1' REPRESENTS A TYPICAL CUSTOMER INSTALLATION ONLY. CUSTOMER INSTALLATIONS MUST BE BUILT AS PER THE ONTARIO ELECTRICAL CODE AND INSPECTED BY THE ELECTRICAL SAFETY AUTHORITY. ALL PARTS SPECIFIED IN THE DETAIL ARE TO BE SUPPLIED BY THE CONTRACTOR.
2. DEPTH OF BURIAL IS MIN. 600mm ON PRIVATE PROPERTY OR 900mm ON ROAD ALLOWANCE. ROAD AUTHORITY APPROVAL REQUIRED WHEN TRENCHING ON ROAD ALLOWANCE SEE DU-03-209.
3. TO FORM DRIP LOOPS CONDUIT CAN BE RUN UP TO HEIGHT OF THE NEUTRAL IF DESIRED.
4. CONNECTION TO NEUTRAL, BUS OR TRANSFORMER TO BE MADE BY HYDRO ONE.

ALL DIMENSIONS ARE IN MILLIMETERS
UNLESS STATED OTHERWISE

PARTS LIST			
PART #	MM #	DESCRIPTION	QTY
①	AS NEEDED	CONDUIT, PVC, RIGID	A/R
②	AS NEEDED	CLAMP	A/R
③	AS NEEDED	TAP CONNECTOR	3
④	AS NEEDED	BOLT LAG	A/R
⑤	AS NEEDED	COVER, CONNECTOR	2
⑥	AS NEEDED	WEATHERHEAD	SUPPLIED BY CONTRACTOR
⑦	AS NEEDED	UNDERGROUND CONDUCTOR	SUPPLIED BY CONTRACTOR
A/R = AS REQUIRED			

REFERENCES:
SECTION 1 - DEFINITIONS
SECTION 3C - CONSTRUCTION GUIDE
SECTION 8 - O/H - U/G TRANSITIONS
SECTION 16 - MATERIALS
O/H DISTRIBUTION STANDARDS

Rev. No.	Issue Date	Revision	Dwn	Approved By	Chk	Date
02	OCT 2011	REVISED D1. ADDED NOTE 4 INCORPORATED DU-08-406 & INCORPORATED DU-08-407	WB	PC	D.F.	
01	MAR 2011	ADDED D1 AND D2 *	PC	*	*	

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Drawn:	Approved:	Date:
W. BURDEN	*	OCT. 31, 2011

1Ø OR 3Ø SECONDARY OVERHEAD TO UNDERGROUND TRANSITIONS (TRIPLEX OR QUADRUPLEX)

Dwg. No. DU-08-405 Rev. 02

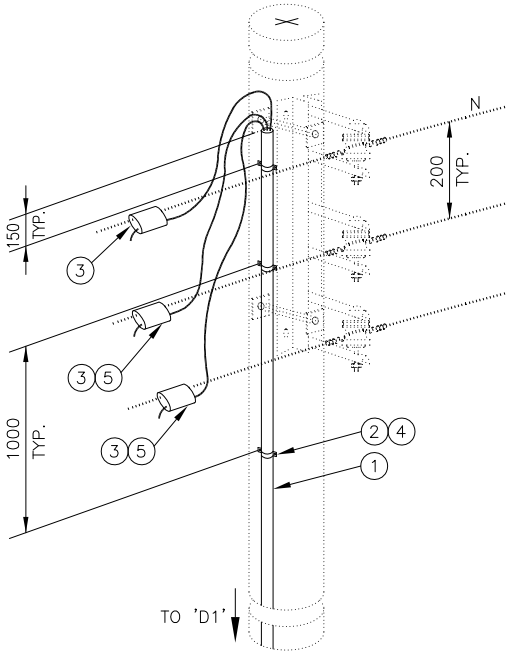
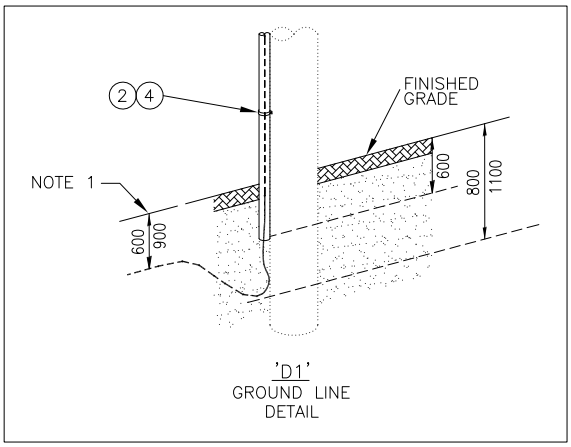
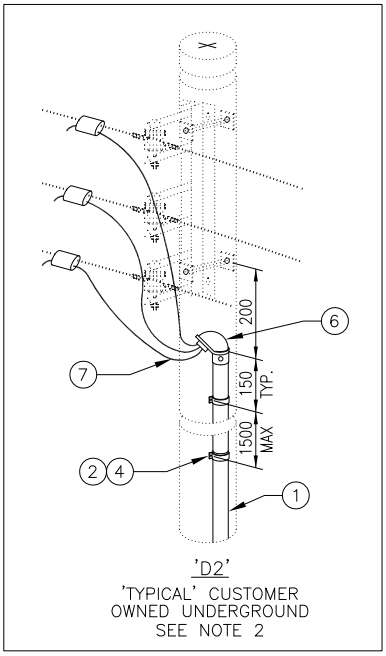


FIG 1:
TRANSITION TO TANGENT
OR LINE ANGLE (0°–60°)



'D1'
GROUND LINE
DETAIL

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
100	4"
150	6"
200	8"
600	2'–0"
800	2'–8"
900	3'–0"
1000	3'–4"
1100	3'–8"



'D2'
'TYPICAL' CUSTOMER
OWNED UNDERGROUND
SEE NOTE 2

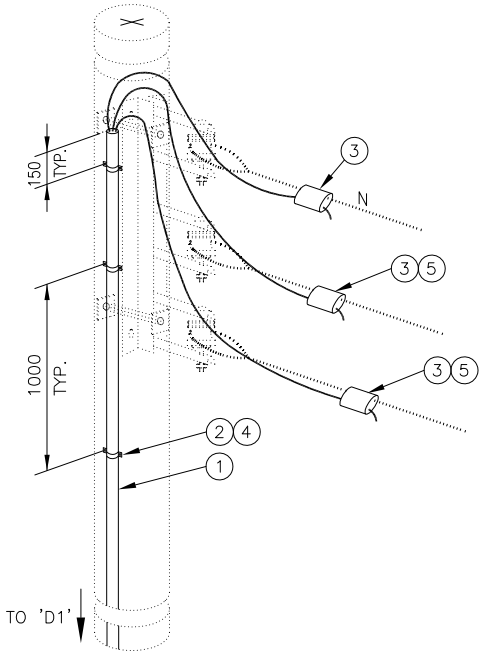


FIG 2:
TRANSITION TO DEADEND

PARTS LIST			
PART Nº	MM Nº	DESCRIPTION	QTY
1	30000744	2" 50mm CONDUIT	AS REQ.'D
	30000746	3" 75mm CONDUIT	AS REQ.'D
	30000831	4" 100mm CONDUIT	AS REQ.'D
2	30000744	2" CLAMP	AS REQ.'D
	30000746	3" CLAMP	AS REQ.'D
	30000831	4" CLAMP	AS REQ.'D
3	AS NEEDED	TAP CONNECTOR	3
4	30001989	BOLT LAG	AS REQ.'D
5	AS NEEDED	COVER, CONNECTOR	2
6	–	WEATHERHEAD	SUPPLIED BY CONTRACTOR
7	–	UNDERGROUND CONDUCTOR	SUPPLIED BY CONTRACTOR

ALL DIMENSIONS ARE IN MILLIMETERS
UNLESS STATED OTHERWISE

REFERENCES:
SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 16 – MATERIALS

NOTE:

1. DEPTH OF BURIAL IS MIN. 600mm ON PRIVATE PROPERTY OR 900mm ON ROAD ALLOWANCE. ROAD AUTHORITY APPROVAL REQUIRED WHEN TRENCHING ON ROAD ALLOWANCE.
2. DETAIL REPRESENTS A TYPICAL INSTALLATION ONLY. DEVIATIONS ARE TO BE BUILT AS PER THE ONTARIO ELECTRICAL CODE AND INSPECTED BY THE ELECTRICAL SAFETY AUTHORITY. ALL PARTS SPECIFIED IN THE DETAIL ARE TO BE SUPPLIED BY THE CONTRACTOR.
3. TO ENSURE FORMATION OF DRIP LOOPS CONDUIT CAN BE RUN UP TO HEIGHT OF THE NEUTRAL IF DESIRED

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
02	NOV 2011	CONDUIT RUN UP TO NEUTRAL MM# ADDED	WB / PC	
01	MAR 2011	ADDED 'D2', NOTES 2 & 3 *	PC / *	* *

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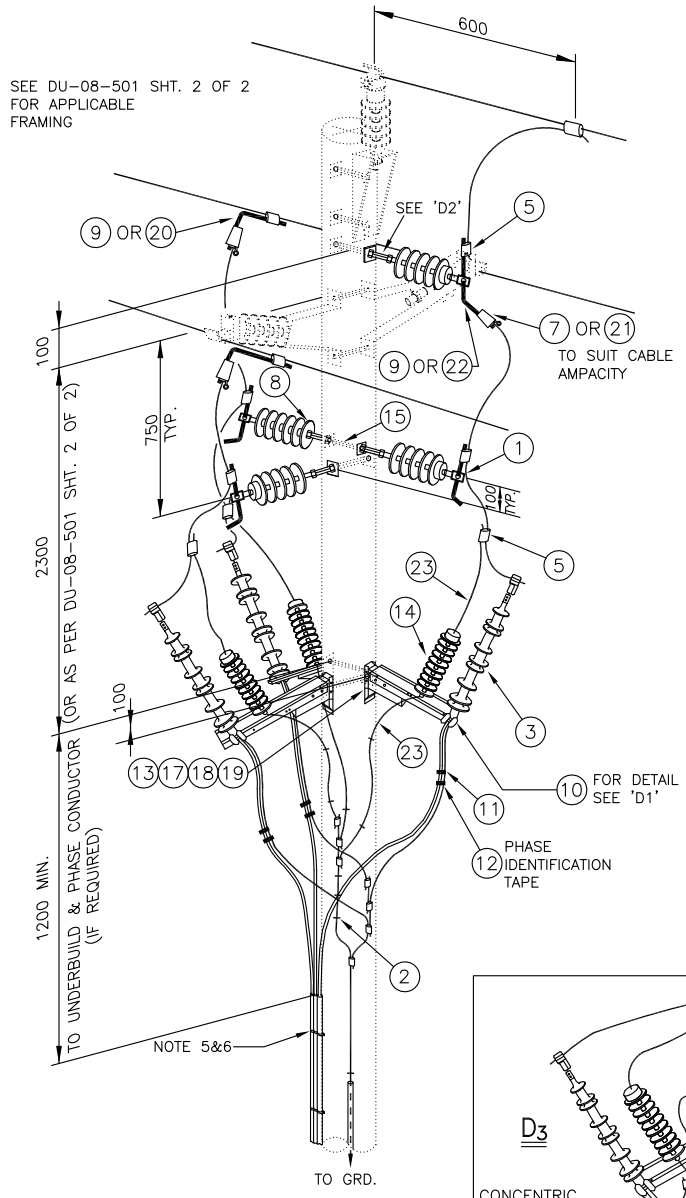
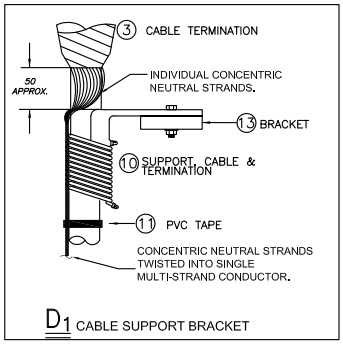
Drawn:	Approved:	Date:
W. BURDEN	*	NOV. 15, 2011

OPEN WIRE BUS: INSTALLATION OF 1Ø
UNDERGROUND SECONDARY

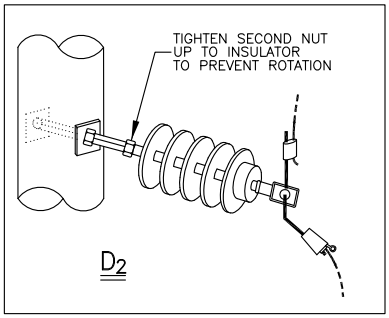
Dwg. No. DU-08-408 Rev. 02



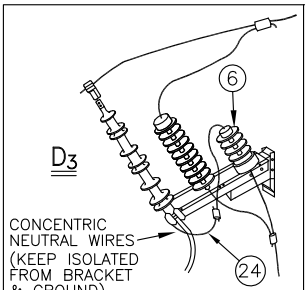
CONVERSION TABLE	
METRIC	IMPERIAL (APPROX)
50mm	0'-2"
100mm	0'-4"
600mm	2'-0"
750mm	2'-6"
900mm	3'-0"
1200mm	4'-0"
2300mm	7'-8"



D1 CABLE SUPPORT BRACKET



D2



FOR HEAVILY LOADED CABLES ONLY (WHERE SPECIFIED BY PLANNER) SEE NOTE 7 & SECTION 13

PART #		DESCRIPTION	QTY.
1	AS NEEDED	BARE COND, COPPER, AS REQ'D	A/R
2	30013881	STAPLE, GROUND WIRE, 3/8" X 1-1/2"	A/R
3	AS NEEDED	TERMINATION, COLD SHRINK, 46kV	3
4	30005821	BARE COND, COPPER, 1/0, 7 STRAND, MHD	A/R
5	AS NEEDED	CONNECTOR, TAP WEDGE, AMP	A/R
6	30016918	ARRESTER, 3kV, IF REQ'D	A/R
7	30006969	CONNECTOR, LIVE LINE, PIGTAIL WEDGE	3
8	10000412	INSULATOR, STANDOFF 44 kV	4
9	30006856	STUD, LIVE LINE	4
10	30008041	SUPPORT, CABLE & TERMINATION	3
11	30008340	TAPE, ELECTRICAL, PVC, BLACK	A/R
12	30010073 30010074 30010072	TAPE, PLASTIC NON TRANSPARENT RED, 3/4" WIDE SAME--WHITE SAME--BLUE	A/R
13	10000049	BRACKET, ALUMAFORM, ARRESTER	3
14	10000230	ARRESTER, INTERMEDIATE, 39kV	3
15	30020499	BOLT, DOUBLE ARMING, 3/4"	1
16	AS NEEDED	BOLT, 3/4"	A/R
17	30001237	BOLT, LAG, 1/2" X 4"	3
18	AS NEEDED	BOLT, 5/8"	2
19	30001594	WASHER, 5/8" X 2" X 2"	A/R
20	30006184	CONNECTOR, STIRUP, BOLTED	A/R
21	30006195	CONNECTOR, LIVE LINE	A/R
22	30000770	CLAMP REST, INSULATOR TYPE	A/R
23	30014480	BARE COND, COPPER, #4AWG	A/R
24	30008332	TAPE, ELEC., INSULATING, SELF-AMALGAMATING	A/R

A/R = AS REQUIRED

REFERENCES:

SECTION 1 – DEFINITIONS
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITIONS
SECTION 13 – CABLE APPLICATION
SECTION 16 – MATERIALS
O/H DISTRIBUTION STANDARDS

NOTES:

1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. MINIMUM BENDING RADIUS 10 x DIAMETER OF CABLE.
3. SEE DU-08-501 SHT. 2 OF 2 FOR APPLICABLE FRAMINGS.
4. DEAD END INSTALLATIONS NOT PREFERRED.
5. POSITION THE CONDUIT SO AS TO ACCOMMODATE A NEUTRAL OR ANY JOINT USE REQUEST.
6. STANDOFF BRACKET CAN BE USED IF THE POLE HAS NO VEHICULAR ACCESS AND SEVERAL CABLES ON THE POLE MAKES IT DIFFICULT TO CLIMB THE POLE, SEE DU-08-303.
7. CONCENTRIC NEUTRALS (CN) CONNECTED TO GROUND VIA 3KV ARRESTERS ON SOURCE SIDE (STATION END) LATERAL ONLY. CONCENTRIC NEUTRALS ON LOAD-SIDE (O/H LINE END) LATERALS CONNECTED DIRECTLY TO GROUND (NO 3KV ARRESTER). SEE DU-13-301. ENSURE ISOLATED CN WIRES ARE WELL AWAY FROM ANY GROUNDED OBJECT. USE INSULATING TAPE ON CN WIRES FROM TERMINATION TO 3kV ARRESTER.

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
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*	* *	* *	* *	* *

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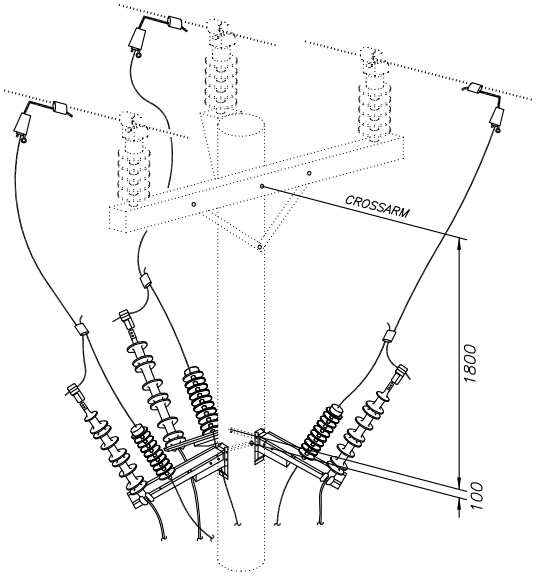
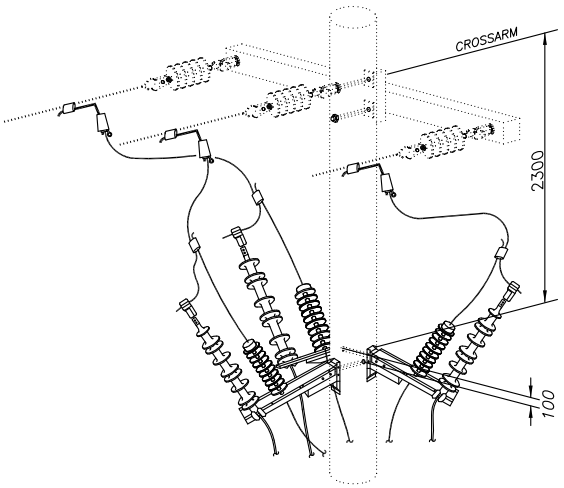
Drawn:	Approved:	Date:
G.OKLECINSKI	*	NOV.15,2011

UNSWITCHED SUBTRANSMISSION CABLE TERMINATION, 3Ø, 44kV (MAX 600A)

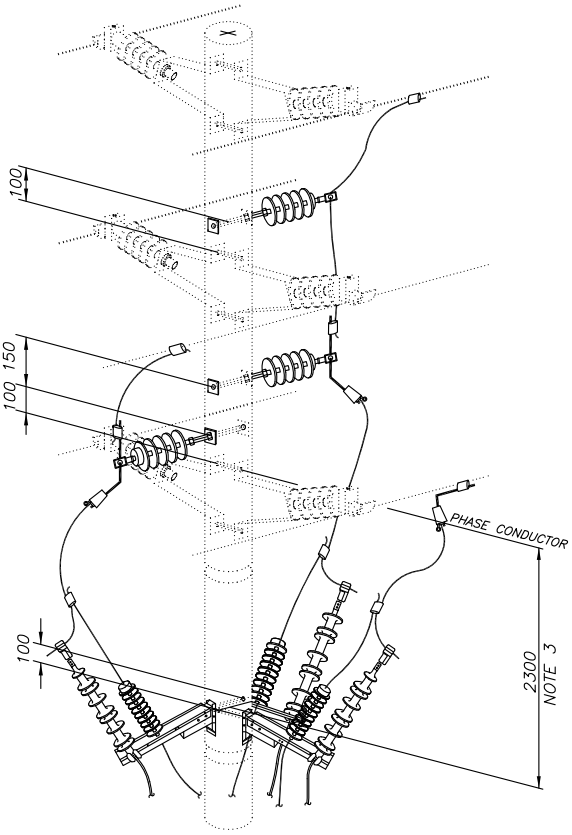
Dwg. No. DU-08-501 SH. 1 OF 2 Rev. 00



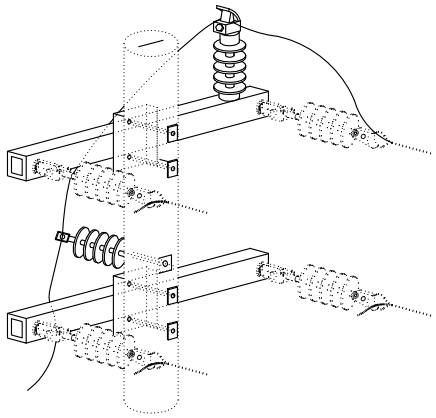
'D1'



'D2'
SEE NOTE 2



'D3'



'D4'
UPPER LP INSULATOR ARRANGEMENT
FOR DL3–212 FRAMING

APPLICABLE FRAMING DRAWINGS		
D1	D2	D3
DL3–220	DL3–205.2	DL3–201
DL3–221	DL3–205.3	DL3–202
		DL3–205.1
		DL3–208.1
		DL3–208.2
		DL3–212
		(SEE NOTE 4)

CONVERSION TABLE	
METRIC	IMPERIAL (APPROX)
100mm	4”
150mm	6”
1100mm	3’–8”
1500mm	5”

ALL DIMENSIONS ARE IN MILLIMETERS
UNLESS STATED OTHERWISE.

REFERENCES

SECTION 1 – DEFINITION
SECTION 3C – CONSTRUCTION GUIDE
SECTION 8 – O/H – U/G TRANSITION
SECTION 16 – MATERIALS LIST
O/H DISTRIBUTION STANDARDS
DU–08–501 SHT. 1 OF 2

NOTES:
1. INSETS SHOW PREFERRED LOCATION FOR TERMINATION/ARRESTER BRACKETS. HOWEVER, THEIR ORIENTATION IS FLEXIBLE AROUND THE POLE.
2. DEAD END INSTALLATIONS NOT PREFERRED.
3. 2300mm TO BE MAINTAINED FROM TERMINATION/ARRESTER BRACKET TO LOWEST PHASE CONDUCTOR.
4. ADDITIONAL LP INSULATOR REQUIRED ON UPPERMOST CROSSARM (SEE 'D4') TO TRAIN DROPLEAD OVER CROSSARM AND DOWN BACKSIDE OF POLE. FURTHERMORE, ENSURE PROPER APPLICATION OF INSULATED GUY RODS TO MAINTAIN ADEQUATE CLEARANCES FROM DOWN GUYS TO DROPLEAD.

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
*	* *	* *	* / *	
*	* *	* *	* / *	

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Drawn:	Approved:	Date:
G.OKLECINSKI	*	NOV. 15, 2011

FRAMING DETAILS FOR UNSWITCHED O/H-U/G TRANSITIONS
3Ø, 44kV

Dwg. No. DU-08-501 SHT. 2 OF 2 Rev. 00

SECTION 9
FOUNDATIONS

Section 9-0
Equipment Foundations

General

This Section provides details of foundations to be used with different pad-mount equipment

The 100 series drawings in this section correspond to general foundation layout drawings for Hydro One approved pad-mounted equipment. These drawings can be used to produce specific foundations for the mentioned equipment. Deviations from these drawings are permitted on a case by case basis. Any foundation manufacturer that is able to meet the drawing specifications is a suitable candidate for supplying foundations. Any foundation part number that is not included in the Table 1 below, must be approved by E&PD before they are utilized.

The 200, 300, and 400 series drawings in this section correspond to the drawings that are close to the currently approved foundation part numbers for transformers, kiosks and switchgear, respectively. These drawings as well as the Table 1 will be updated whenever additional foundation designs are approved.

Series 500 drawings are for miscellaneous parts that are sometime used with foundations for certain specific applications.

TABLE 1

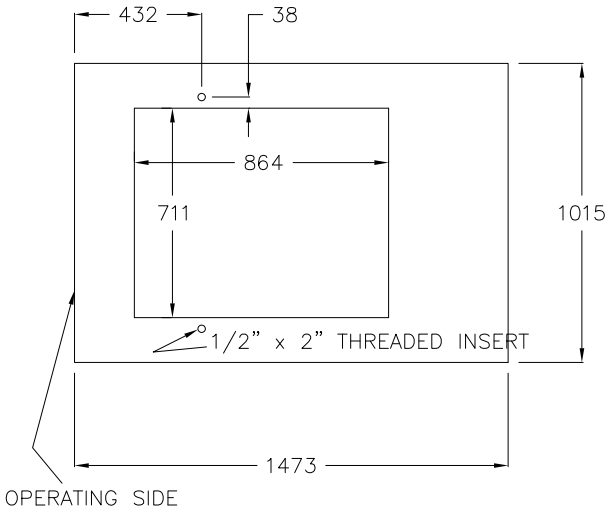
Transformers	DWG	Brooklin Concrete	
		Foundation	Lid
1Ø	DU-09-201	BCP 110PC	-
3Ø (150 - 500 kVA)	DU-09-202	BCP 114P	BCP 114T6
3Ø (500 - 1,000 kVA)	DU-09-203	BCP 114PB	BCP 114TBB9

Kiosk	DWG	Brooklin Concrete	
		Foundation	Lid
Camtran – Standard			
1Ø	DU-09-301	BCP 110PC	BCP 110 THO1
3Ø	DU-09-302	BCP 111P	BCP 111 THO3

Switchgear	DWG	Brooklin Concrete	
		Foundation	Lid
Single Phase			
Elastimold - 1Ø, 4-way	DU-09-401	BCP 110PC	BCP 110 THOE1
Three Phase			
CPP - 3Ø, 3-way	DU-09-402	BCP 114P	BCP 114THO
CPP - 3Ø, 4-way	DU-09-403	BCP 111P	BCP 111TGW (HO1 or HO2)
CPP - 3Ø, 5-way	DU-09-404	BCP 400P	BCP 400TGW HO

In This Section This section contains the following drawings:

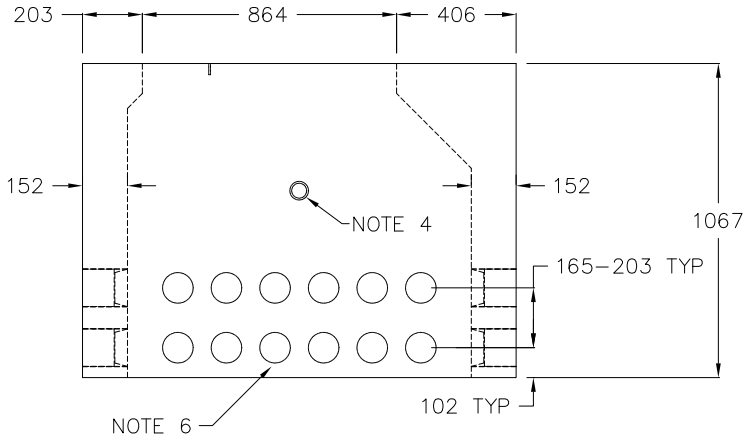
Description	Dwg. #	Rev.
Foundation Specifications for Single Phase Transformers	DU-09-101	R0
Foundation Specifications for Three Phase Transformers	DU-09-102	R0
Foundation Specifications for CamTran Single and Three Phase Kiosks	DU-09-103	R0
Foundation Specifications for Elastimold Single Switchgear	DU-09-104	R0
Foundation Specifications for CPP Three Phase Switchgear	DU-09-105	R0
Typical Concrete Foundation – Single Phase Padmount Transformer	DU-09-201	R0
Typical Concrete Foundation – Three Phase Padmount Transformer (150-500kVA)	DU-09-202	R0
Typical Concrete Foundation – Three Phase Padmount Transformer (500-1,000kVA)	DU-09-203	R0
Typical Concrete Foundation – Single Phase Camtran Kiosk (15 & 28kV, 3 & 4way)	DU-09-301	R0
Typical Concrete Foundation – Three Phase Camtran Kiosk (15 & 28kV, 3 & 4way)	DU-09-302	R0
Typical Concrete Foundation – Single Phase Elastimold Switchgear (4-Way)	DU-09-401	R0
Typical Concrete Foundation – Three Phase CPP Switchgear (3-Way)	DU-09-402	R0
Typical Concrete Foundation – Three Phase CPP Switchgear (4-Way)	DU-09-403	R0
Typical Concrete Foundation – Three Phase CPP Switchgear (5-Way)	DU-09-404	R0
Precast Collar For Padmount Grade Adjustment	DU-09-501	R0
Temporary Steel Cover for Single Phase Transformer Foundation	DU-09-502	R0



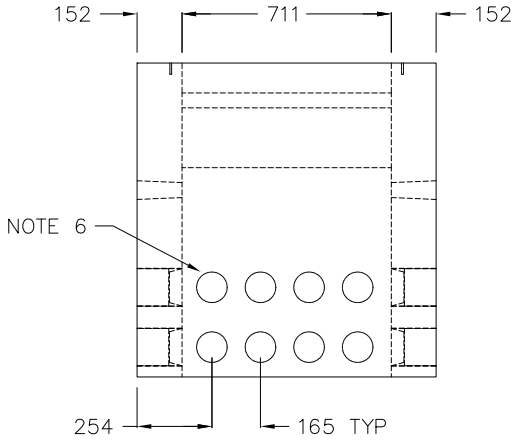
FOUNDATION TOP VIEW

EQUIPMENT WEIGHT

UP TO 820 KG (1800 LBS.)



FOUNDATION FRONT VIEW



FOUNDATION RIGHT VIEW

NOTES:
1. UNLESS SPECIFIED OTHERWISE, THE DIMENSIONS ARE IN mm.
2. REINFORCING STEEL TO CSA A23.1 AND A23.3.
3. CONCRETE – 30MPA MIN. STRENGTH, 6–8% AIR ENTRAINMENT.
4. PROVIDE 50mm LIFTING HOLES
5. ONE SINGLE PIECE FOUNDATION PREFERRED.
6. PREFERABLY 12 (100mm I.D.) PVC SEALS ON THE LONGER SIDE, HOWEVER 8 IS THE MINIMUM.
7. OUTLINE DIMENSIONS ARE MINIMUM. FOUNDATIONS WITH LARGER DIMENSIONS MAY BE ACCEPTED AT THE DISCRETION OF HYDRO ONE.

Rev. No.	Issue Date	Revision	Dwn	Approved By
*	* *	* *	* *	* *

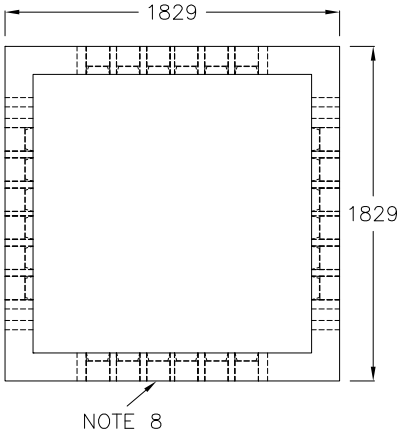
Chk Date

hydro one **Hydro One Networks Inc.**

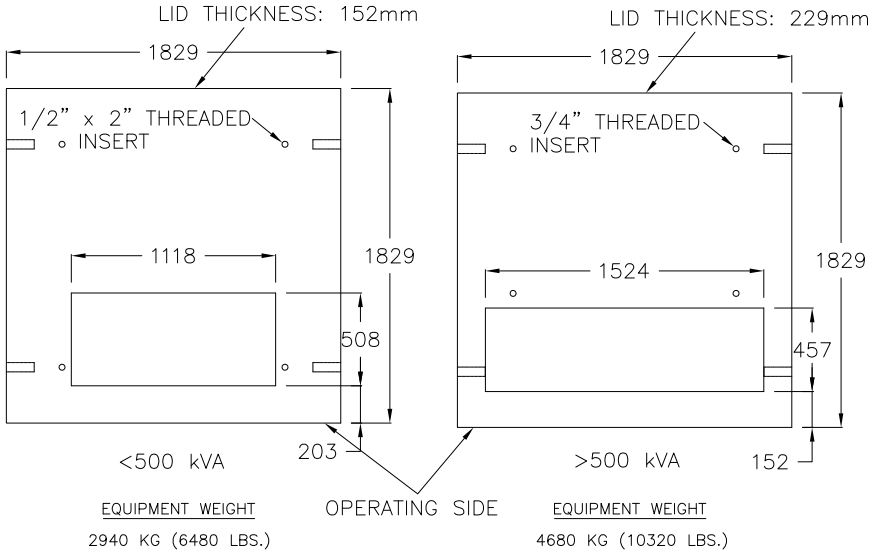
Drawn:	Approved:	Date:
S.OORT	*	NOV. 15, 2011

FOUNDATION SPECIFICATIONS FOR SINGLE PHASE TRANSFORMERS

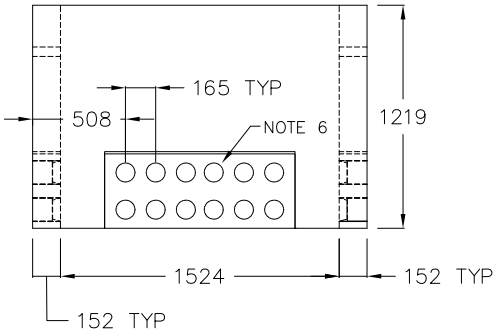
Dwg. No. DU-09-101 Rev. 00



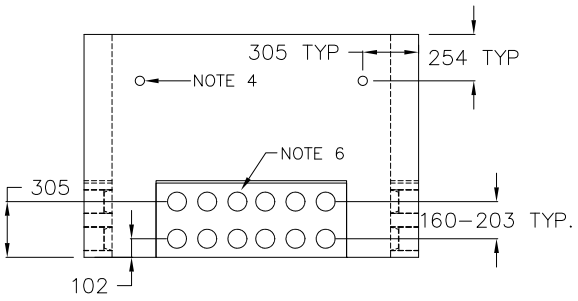
FOUNDATION TOP VIEW



LID TOP VIEW



FOUNDATION FRONT VIEW



FOUNDATION RIGHT VIEW

NOTES:
1. UNLESS SPECIFIED OTHERWISE, THE DIMENSIONS ARE IN mm.
2. REINFORCING STEEL TO CSA A23.1 AND A23.3.
3. CONCRETE – 30MPA MIN. STRENGTH, 6–8% AIR ENTRAINMENT.
4. PROVIDE 50mm LIFTING HOLES.
5. TWO PIECE (FOUNDATION + LID) ACCEPTABLE.
6. PREFERABLY 12 (100mm I.D.) PVC SEALS ON EACH SIDE, HOWEVER 8 IS THE MINIMUM.
7. OUTLINE DIMENSIONS ARE MINIMUM. FOUNDATIONS WITH LARGER DIMENSIONS MAY BE ACCEPTED AT THE DISCRETION OF HYDRO ONE.
8. FOUNDATION MAY REQUIRE A BASE FOR TRANSFORMERS >500kVA. BASE MAY BE MONOLITHIC, OR A SEPARATE PIECE.

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
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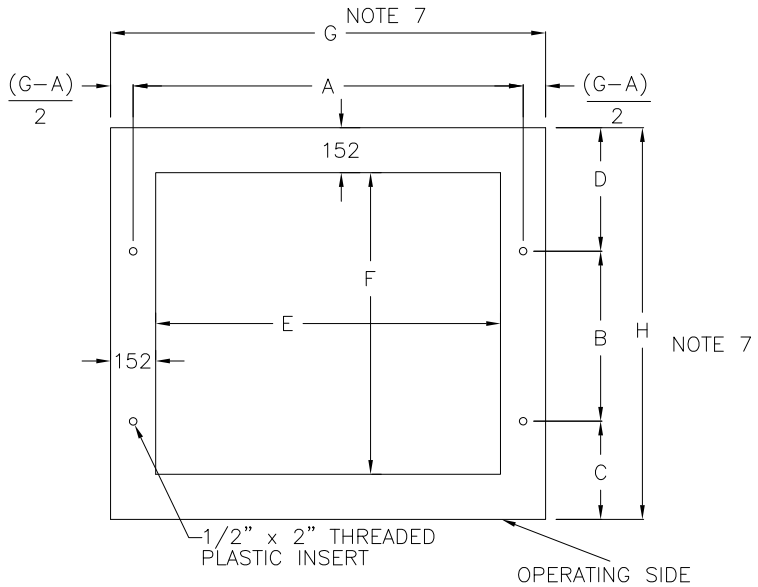
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV. 15, 2011

FOUNDATION SPECIFICATIONS FOR THREE PHASE TRANSFORMERS

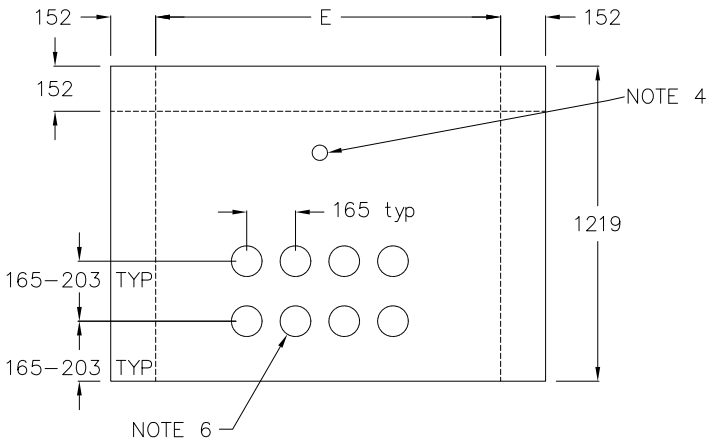
Dwg. No. DU-09-102 Rev. 00



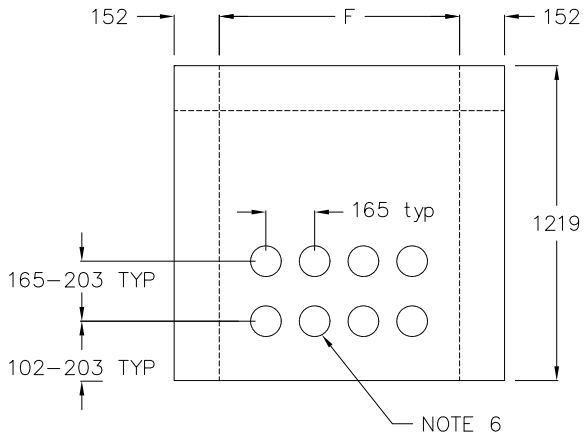
FOUNDATION TOP VIEW

EQUIPMENT WEIGHT

SINGLE PHASE – 25 KG (55 LBS.)
THREE PHASE – 55 KG (120 LBS.)



FRONT VIEW



SIDE VIEW

NOTES:
1. UNLESS SPECIFIED OTHERWISE, THE DIMENSIONS ARE IN mm.
2. REINFORCING STEEL TO CSA A23.1 AND A23.3.
3. CONCRETE – 30MPA MIN. STRENGTH, 6–8% AIR ENTRAINMENT.
4. PROVIDE 50mm LIFTING HOLES
5. ONE SINGLE PIECE FOUNDATION OR TWO PIECE (FOUNDATION + LID) ACCEPTABLE.
6. PREFERABLY 12 (100mm I.D.) PVC SEALS ON EACH LONGER SIDE OF THREE PHASE EQUIPMENT, HOWEVER 8 IS THE MINIMUM.
7. OUTLINE DIMENSIONS ARE MINIMUM. FOUNDATIONS WITH LARGER DIMENSIONS MAY BE ACCEPTED AT THE DISCRETION OF HYDRO ONE.

DIMENSIONS								
EQUIPMENT TYPE	INSERTS				OPENING		OUTLINE	
	LENGTH	WIDTH	EDGE 1	EDGE 2	LENGTH	WIDTH	LENGTH	WIDTH
	A	B	C	D	E	F	G	H
SINGLE PHASE KIOSK	838 33"	457 18"	216 8.5"	114 10.5"	686 27"	635 25"	991 39"	940 37"
THREE PHASE KIOSK	1638 64.5"	483 19"	216 8.5"	318 12.5"	1486 58.5"	711 28"	1791 70.5"	1016 40"

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
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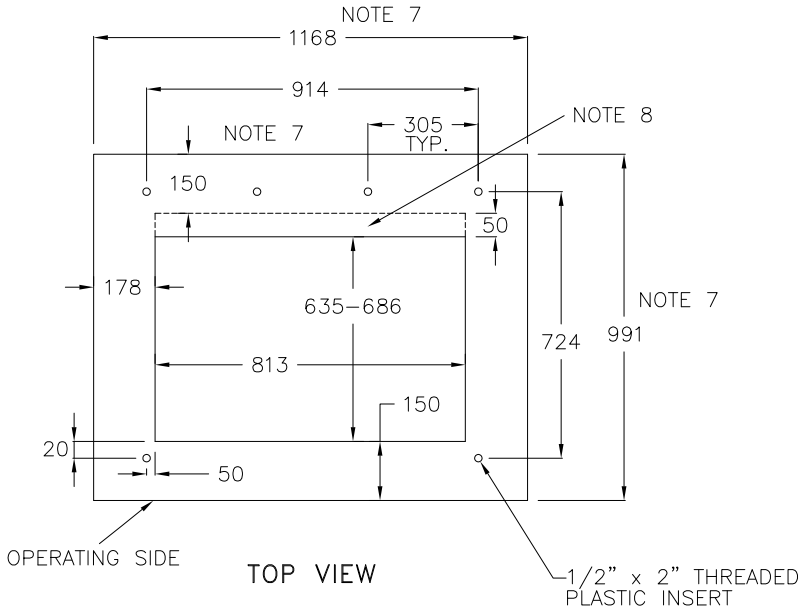
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV. 15, 2011

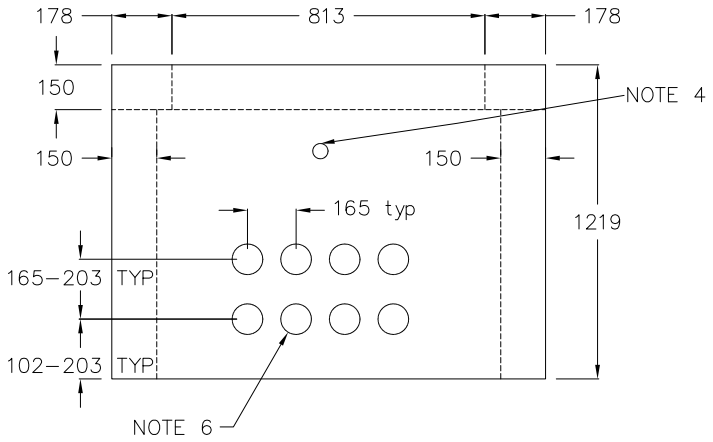
FOUNDATION SPECIFICATIONS FOR CAMTRAN SINGLE & THREE PHASE KIOSKS

Dwg. No. DU-09-103 Rev. 00

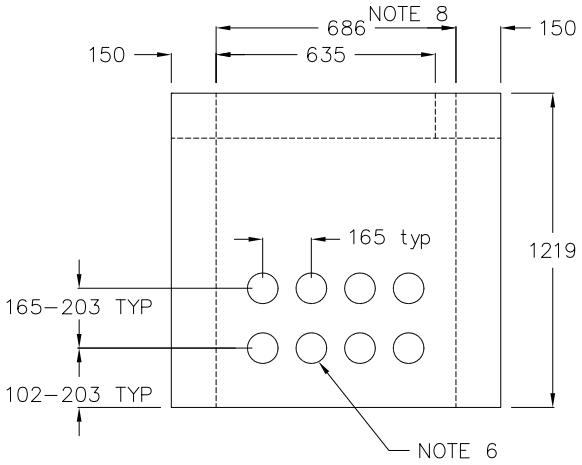


EQUIPMENT WEIGHT

300 KG (660 LBS.)



FRONT VIEW



SIDE VIEW

NOTES:
1. UNLESS SPECIFIED OTHERWISE, THE DIMENSIONS ARE IN mm.
2. REINFORCING STEEL TO CSA A23.1 AND A23.3.
3. CONCRETE – 30MPA MIN. STRENGTH, 6–8% AIR ENTRAINMENT.
4. PROVIDE 50mm LIFTING HOLES
5. ONE SINGLE PIECE FOUNDATION OR TWO PIECE (FOUNDATION + LID) ACCEPTABLE.
6. PREFERABLY 10 (100mm I.D.) PVC SEALS ON EACH SIDE, HOWEVER 8 IS THE MINIMUM.
7. OUTLINE DIMENSIONS ARE MINIMUM. FOUNDATIONS WITH LARGER DIMENSIONS MAY BE ACCEPTED AT THE DISCRETION OF HYDRO ONE.
8. 635mm IS THE PREFERRED OPENING WIDTH, HOWERVER 686mm IS ACCEPTABLE.

Rev. No.	Issue Date	Revision	Dwn	Approved By / Date
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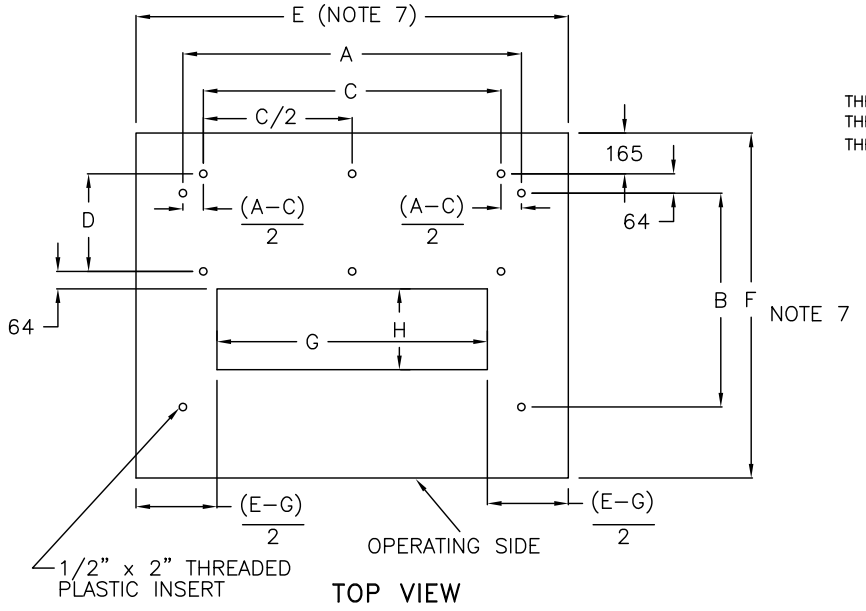
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV. 16, 2011

FOUNDATION SPECIFICATIONS FOR ELASTIMOLD SINGLE PHASE SWITCHGEAR

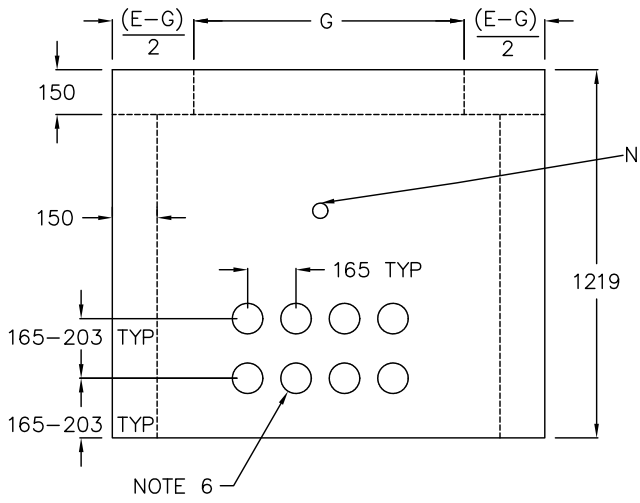
Dwg. No. DU-09-104 Rev. 00



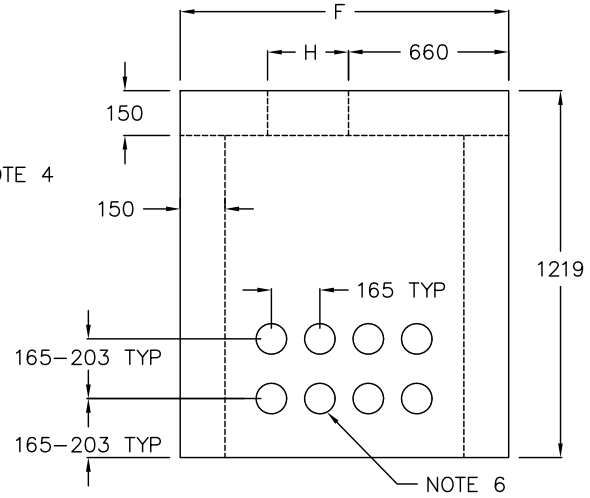
TOP VIEW

EQUIPMENT WEIGHT

THREE PHASE 3–WAY: 726 KG (1600 LBS.)
THREE PHASE 4–WAY: 726 KG (1600 LBS.)
THREE PHASE 5–WAY: 771 KG (1700 LBS.)



FRONT VIEW



SIDE VIEW

NOTES:
1. UNLESS SPECIFIED OTHERWISE, THE DIMENSIONS ARE IN mm.
2. REINFORCING STEEL TO CSA A23.1 AND A23.3.
3. CONCRETE – 30MPA MIN. STRENGTH, 6–8% AIR ENTRAINMENT.
4. PROVIDE 50mm LIFTING HOLES
5. ONE SINGLE PIECE FOUNDATION OR TWO PIECE (FOUNDATION + LID) ACCEPTABLE.
6. PREFERABLY 12 (100mm I.D.) PVC SEALS ON EACH SIDE, HOWEVER 8 IS THE MINIMUM.
7. OUTLINE DIMENSIONS ARE MINIMUM. FOUNDATIONS WITH LARGER DIMENSIONS MAY BE ACCEPTED AT THE DISCRETION OF HYDRO ONE.

DIMENSIONS								
EQUIPMENT TYPE	ENCLOSURE		FRAME		OUTLINE		OPENING	
	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
	A	B	C	D	E	F	G	H
CPP, THREE PHASE, 3–WAY	1588 62.5"	965 38"	1445 56–7/8"	432 17"	1803 71"	1422 56"	1397 55"	483 19"
CPP, THREE PHASE, 4–WAY	1816 71.5"	965 38"	1673 65–7/8"	432 17"	2032 80"	1422 56"	1651 65"	660 26"
CPP, THREE PHASE, 4–WAY 6TT6/783A	1791 70.5"	965 38"	1648 64–7/8"	432 17"	2007 79"	1422 56"	1651 65"	660 26"
CPP, THREE PHASE, 5–WAY	2197 86.5"	965 38"	2054 80–7/8"	432 17"	2413 95"	1422 56"	2057 81"	635 25"

Rev. No.	Issue Date	Revision	Dwn	Approved By / Date
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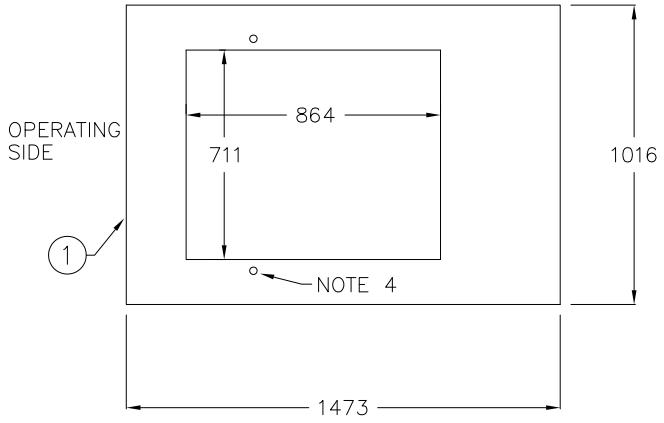
hydro one **Hydro One Networks Inc.**

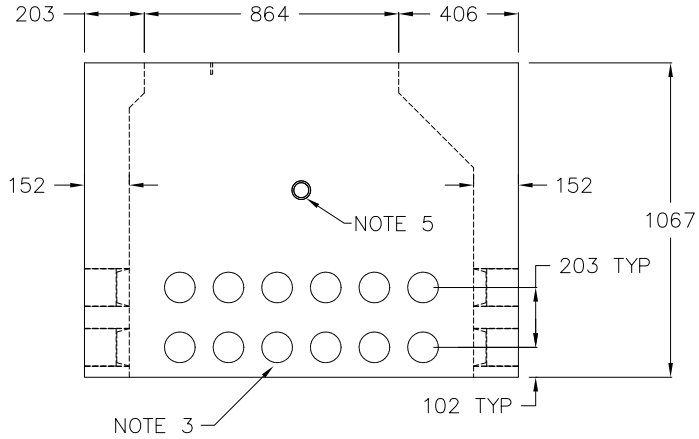
Drawn:	Approved:	Date:
S.OORT	*	NOV. 15, 2011

FOUNDATION SPECIFICATIONS FOR CPP THREE PHASE SWITCHGEAR

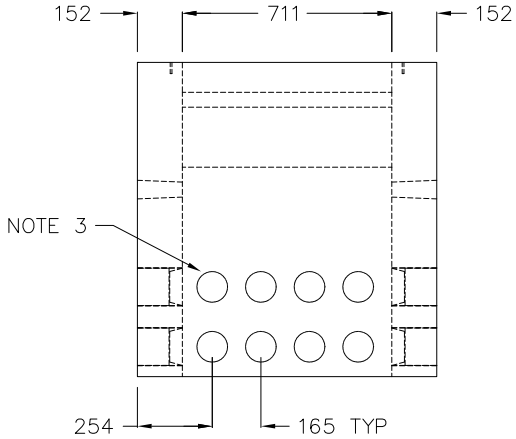
Dwg. No. DU-09-105 Rev. 00



FOUNDATION TOP VIEW



FOUNDATION FRONT VIEW



FOUNDATION RIGHT VIEW

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. APPROXIMATE MASS OF FOUNDATION IS 1540 kG.
3. CABLE ENTRY OPENINGS: PVC SEALS FOR 100mm DUCTS.
4. 1/2" x 2" N.C. PLASTIC THREADED INSERT.
5. 50mm LIFTING HOLE.

PART #	MM #	DESCRIPTION	QTY.
1	30013011	CONCRETE FOUNDATION – BROOKLIN CONCRETE BCP 110PC (OR EQUIVALENT)	1

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
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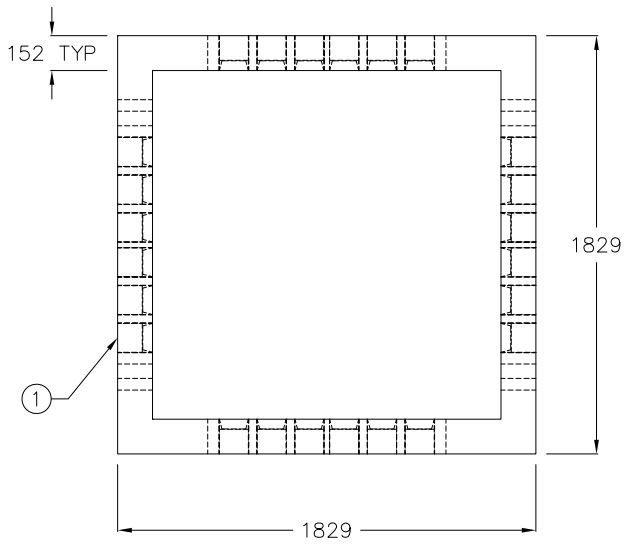
hydro one **Hydro One Networks Inc.**

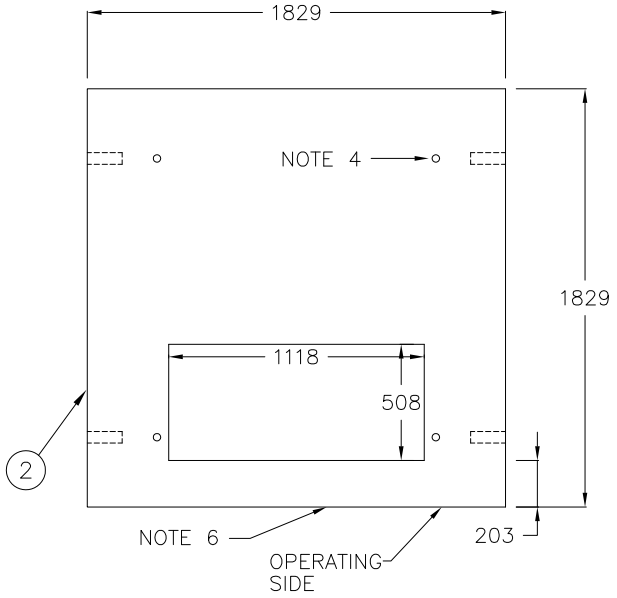
Drawn:	Approved:	Date:
S.OORT	*	NOV. 08, 2011

TYPICAL CONCRETE FOUNDATION - SINGLE PHASE PADMOUNT TRANSFORMER

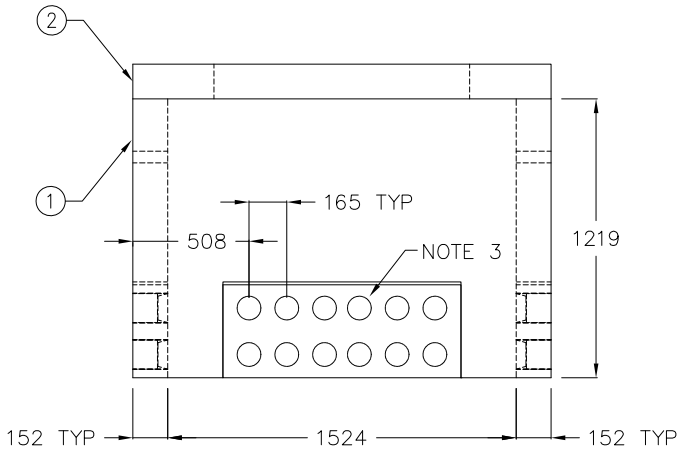
Dwg. No. DU-09-201 Rev. 00



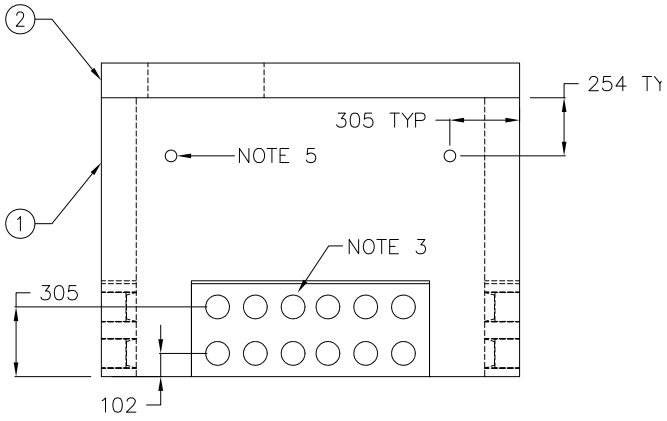
FOUNDATION TOP VIEW



LID TOP VIEW



FOUNDATION FRONT VIEW



FOUNDATION RIGHT VIEW

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. APPROXIMATE MASS OF FOUNDATION IS 2730 kG.
3. CABLE ENTRY OPENINGS: PVC SEALS FOR 100mm DUCTS.
4. 1/2" x 2" N.C. PLASTIC THREADED INSERT.
5. 50mm LIFTING HOLE.
6. LID THICKNESS = 152mm, LID MASS = 1000 kG.

PART #	MM #	DESCRIPTION	QTY.
1	30013789	CONCRETE FOUNDATION – BROOKLIN CONCRETE BCP 114P (OR EQUIVALENT)	1
2		CONCRETE LID – BROOKLIN CONCRETE BCP 114T6 (OR EQUIVALENT)	1

Rev. No.	Issue Date	Revision	Dwn	Approved By
*	* *	* *	* *	* *

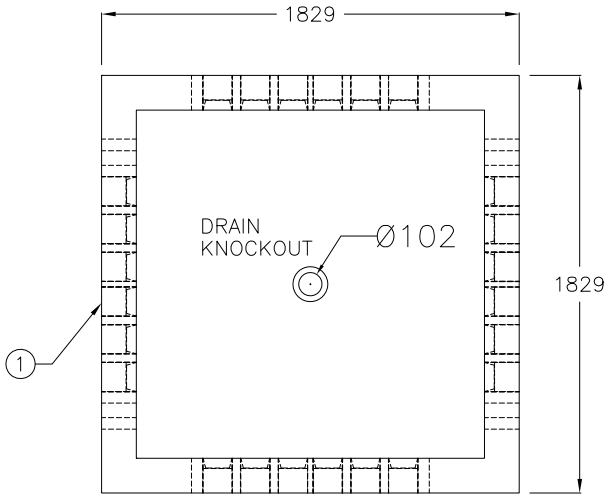
Chk Date

hydro one **Hydro One Networks Inc.**

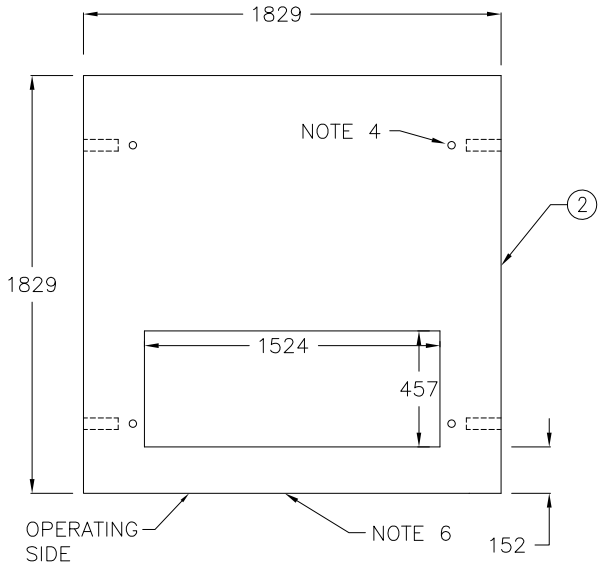
Drawn:	Approved:	Date:
S.OORT	*	NOV. 01, 2011

TYPICAL CONCRETE FOUNDATION - THREE PHASE PADMOUNT TRANSFORMER (150-500kVA)

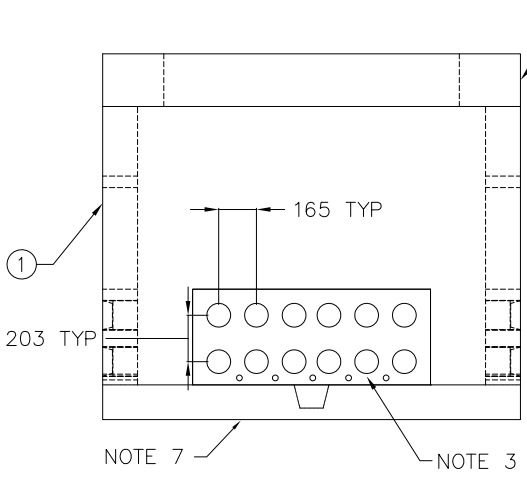
Dwg. No. DU-09-202 Rev. 00



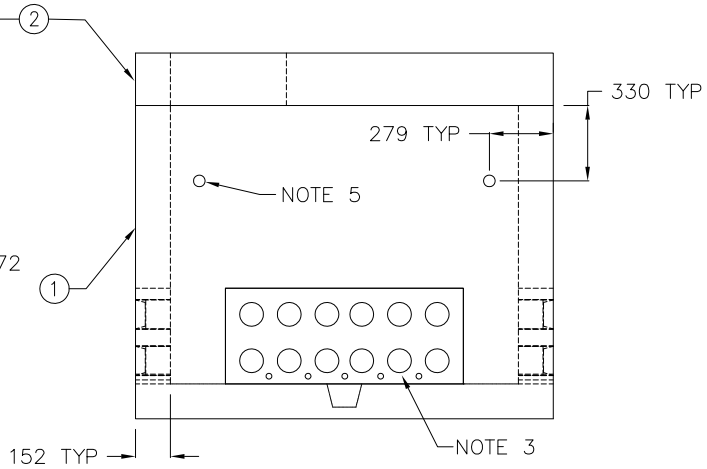
FOUNDATION TOP VIEW



LID TOP VIEW



FOUNDATION FRONT VIEW



FOUNDATION RIGHT VIEW

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. APPROXIMATE FOUNDATION MASS IS 3985 kG.
3. CABLE ENTRY OPENINGS: PVC SEALS FOR 100mm DUCTS.
4. 3/4" x 2" N.C. GALV THREADED INSERT TYP.
5. 50mm LIFTING HOLE.
6. LID THICKNESS = 230 mm, LID MASS = 1320 kG.
7. OPTION TO USE BCP 114P WITH BCP 114B (OR EQUIVALENTS).

PART #	MM #	DESCRIPTION	QTY.
1	N/A	CONCRETE FOUNDATION – BROOKLIN CONCRETE BCP 114PB (OR EQUIVALENT)	1
2	N/A	CONCRETE LID – BROOKLIN CONCRETE BCP 114TBB9 (OR EQUIVALENT)	1

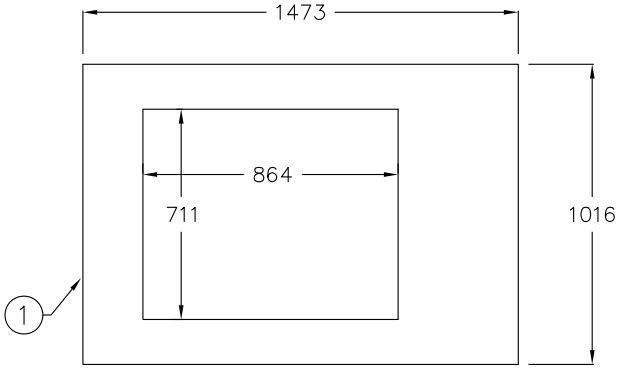
Rev. No.	Issue Date	Revision	Dwn	Approved By / Chk Date
*	* *	* *	* *	* *

hydro one **Hydro One Networks Inc.**

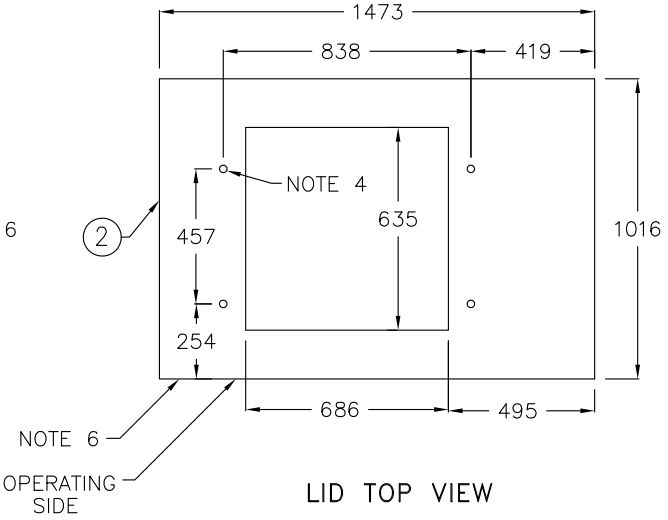
Drawn:	Approved:	Date:
S.OORT	*	NOV. 08, 2011

TYPICAL CONCRETE FOUNDATION - THREE PHASE PADMOUNT TRANSFORMER (500 - 1000kVA)

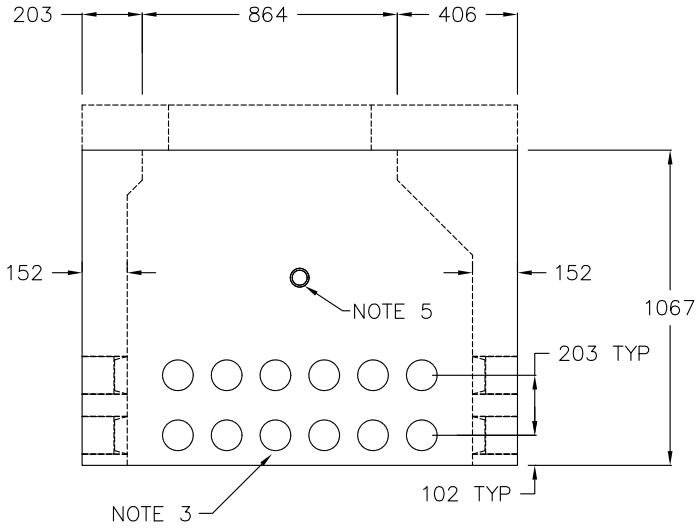
Dwg. No. DU-09-203 Rev. 00



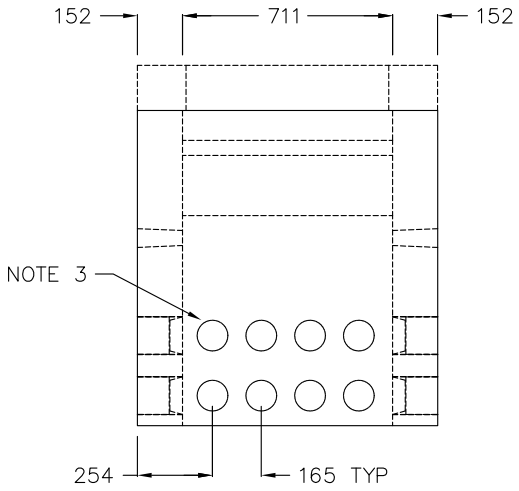
FOUNDATION TOP VIEW



LID TOP VIEW



FOUNDATION FRONT VIEW



FOUNDATION RIGHT VIEW

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. APPROXIMATE MASS OF FOUNDATION IS 1540 kG.
3. CABLE ENTRY OPENINGS: PVC SEALS FOR 100mm DUCTS.
4. 1/2" x 2" N.C. PLASTIC THREADED INSERT.
5. 50mm LIFTING HOLE.
6. LID THICKNESS = 152mm, LID MASS = 243 kG.

PART #	MM #	DESCRIPTION	QTY.
1	30013011	CONCRETE FOUNDATION – BROOKLIN CONCRETE BCP 110PC (OR EQUIVALENT)	1
2	N/A	CONCRETE LID – BROOKLIN CONCRETE BCP 110 THO 1 (OR EQUIVALENT)	1

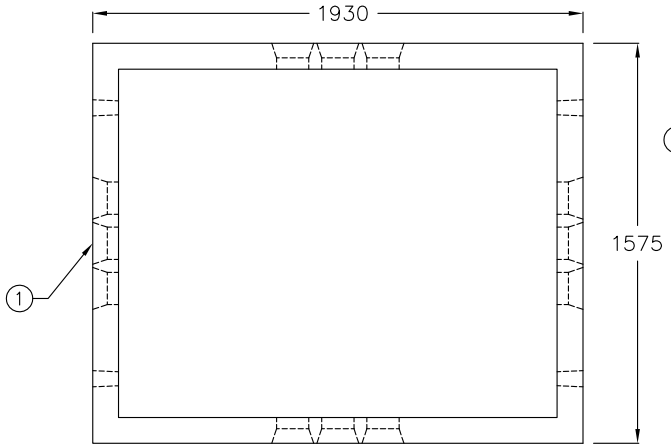
Rev. No.	Issue Date	Revision	Dwn	Approved By
*	* *	* *	* *	* *
			Chk	Date

hydro one **Hydro One Networks Inc.**

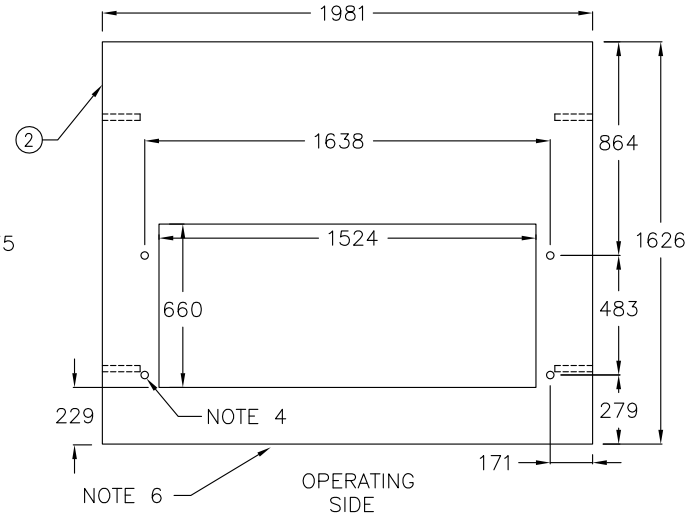
Drawn:	Approved:	Date:
S.OORT	*	NOV. 15, 2011

TYPICAL CONCRETE FOUNDATION - SINGLE PHASE CAMTRAN KIOSK (15 & 28kV, 3 & 4 WAY)

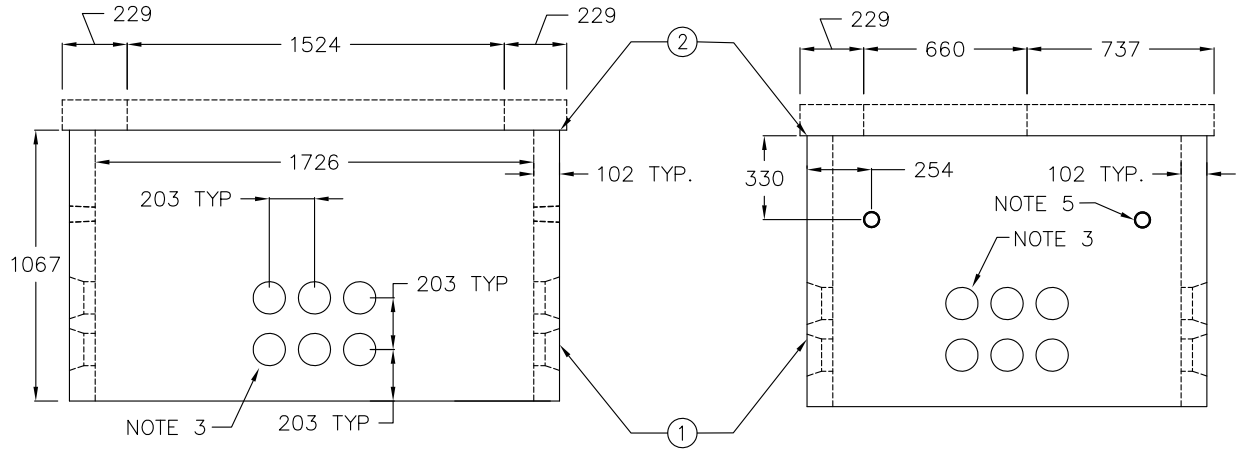
Dwg. No. DU-09-301 Rev. 00



FOUNDATION TOP VIEW



LID TOP VIEW



FOUNDATION FRONT VIEW

FOUNDATION RIGHT VIEW

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. APPROXIMATE MASS OF FOUNDATION IS 1590 kG.
3. CABLE ENTRY OPENINGS: PVC SEALS FOR 100mm DUCTS.
4. 1/2" N.C. PLASTIC THREADED INSERT.
5. 50mm LIFTING HOLE.
6. LID THICKNESS = 152mm, LID MASS = 572 kG.

PART #	MM #	DESCRIPTION	QTY.
1	N/A	CONCRETE FOUNDATION – BROOKLIN CONCRETE BCP 111P (OR EQUIVALENT)	1
2	N/A	CONCRETE LID – BROOKLIN CONCRETE BCP 111TH03 (OR EQUIVALENT)	1

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
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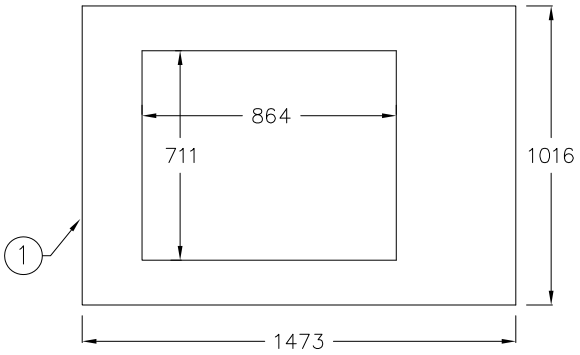
hydro one **Hydro One Networks Inc.**

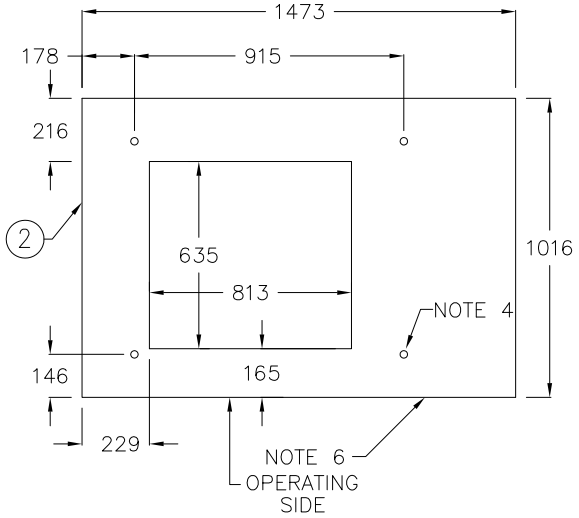
Drawn:	Approved:	Date:
S.OORT	*	NOV. 15, 2011

TYPICAL CONCRETE FOUNDATION - THREE PHASE CAMTRAN KIOSK (15 & 28kV, 3 & 4 WAY)

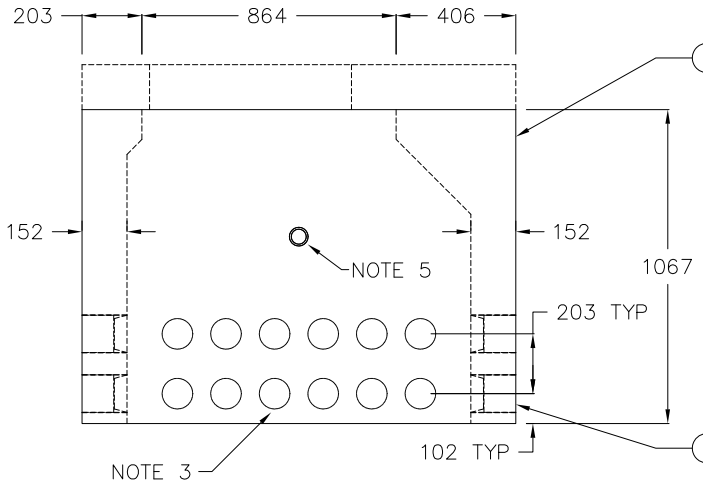
Dwg. No. DU-09-302 Rev. 00



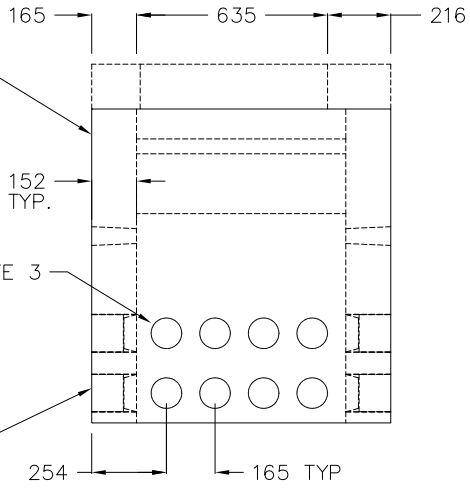
FOUNDATION TOP VIEW



LID TOP VIEW



FOUNDATION FRONT VIEW



FOUNDATION RIGHT VIEW

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. APPROXIMATE MASS OF FOUNDATION IS 1540 kG.
3. CABLE ENTRY OPENINGS: PVC SEALS FOR 100mm DUCTS.
4. 1/2" N.C. PLASTIC THREADED INSERT.
5. 50mm LIFTING HOLE.
6. LID THICKNESS = 152mm, LID MASS = 242 kG.

PART #	MM #	DESCRIPTION	QTY.
1	30013011	CONCRETE FOUNDATION – BROOKLIN CONCRETE BCP 110PC (OR EQUIVALENT)	1
2	N/A	CONCRETE LID – BROOKLIN CONCRETE BCP 110 THOE1 (OR EQUIVALENT)	1

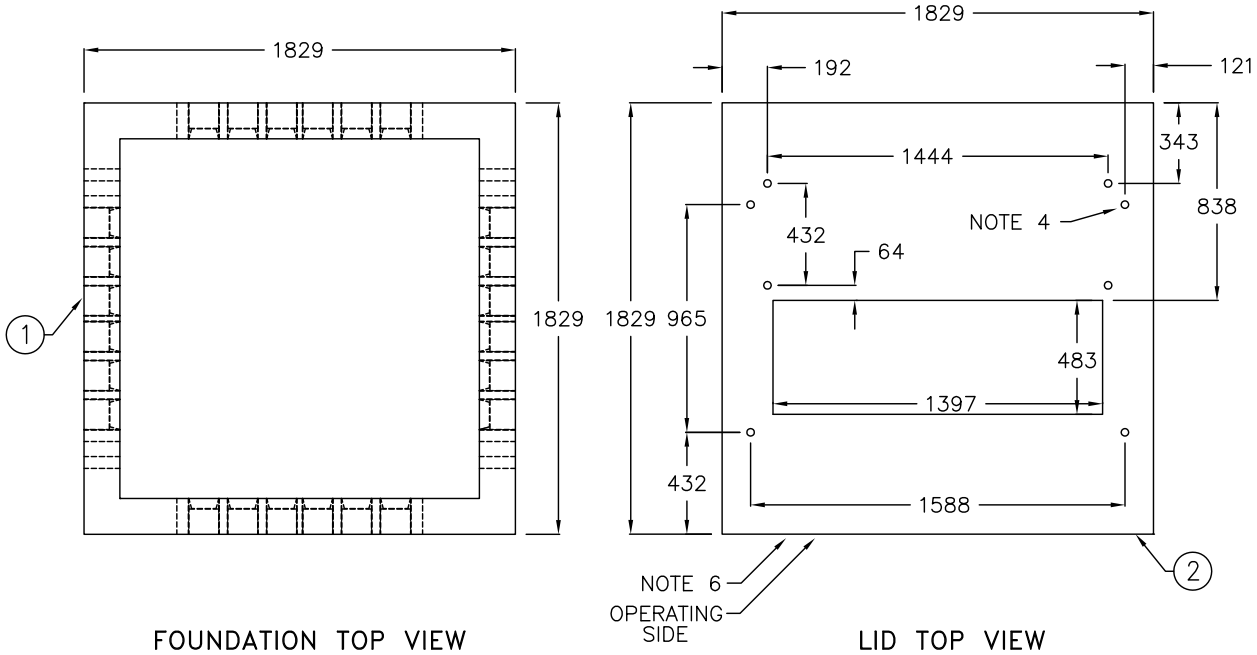
Rev. No.	Issue Date	Revision	Dwn	Approved
*	*	*	*	*
	*	*	Chk	By
				Date

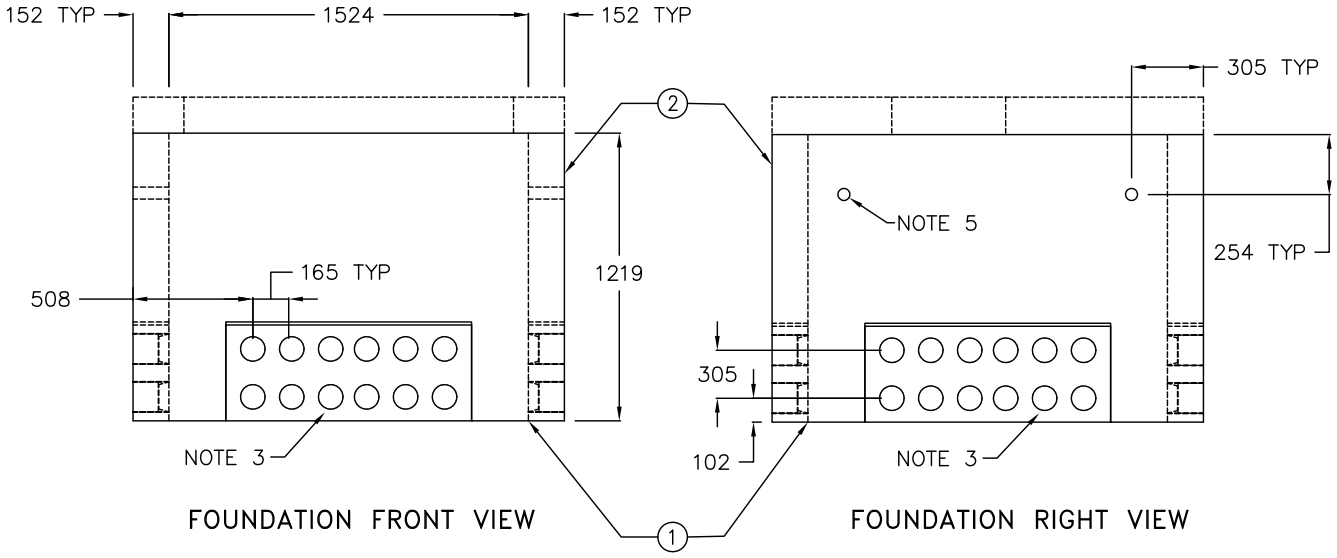
hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
S.OORT	*	NOV. 15, 2011

TYPICAL CONCRETE FOUNDATION - SINGLE PHASE ELASTIMOLD SWITCHGEAR (4 - WAY)

Dwg. No. DU-09-401 Rev. 00





NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. APPROXIMATE MASS OF FOUNDATION IS 2730 kG.
3. CABLE ENTRY OPENINGS: PVC SEALS FOR 100mm DUCTS.
4. 1/2" N.C. PLASTIC THREADED INSERT.
5. 50mm LIFTING HOLE.
6. LID THICKNESS = 152mm, LID MASS = 690 kG.

PART #	MM #	DESCRIPTION	QTY.
1	N/A	CONCRETE FOUNDATION – BROOKLIN CONCRETE BCP 114P (OR EQUIVALENT)	1
2	N/A	CONCRETE LID – BROOKLIN CONCRETE BCP 114–THO (OR EQUIVALENT)	1

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
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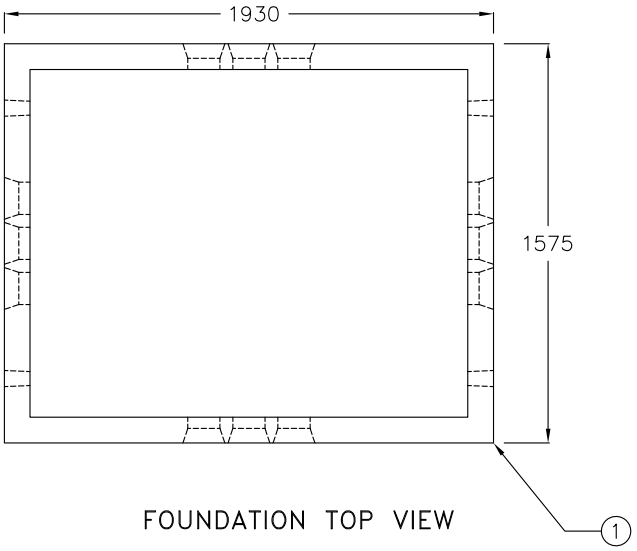
hydro one **Hydro One Networks Inc.**

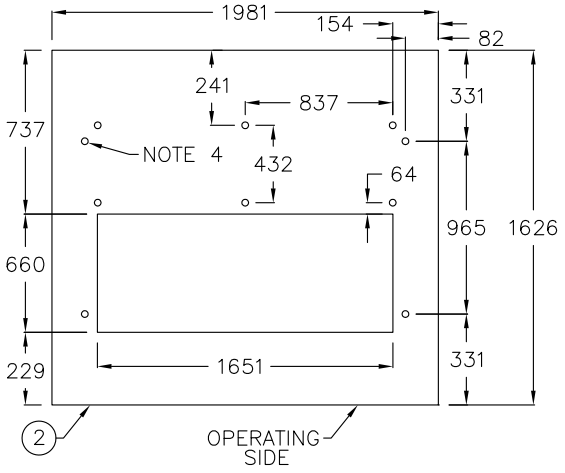
Drawn:	Approved:	Date:
S.OORT	*	NOV. 15, 2011

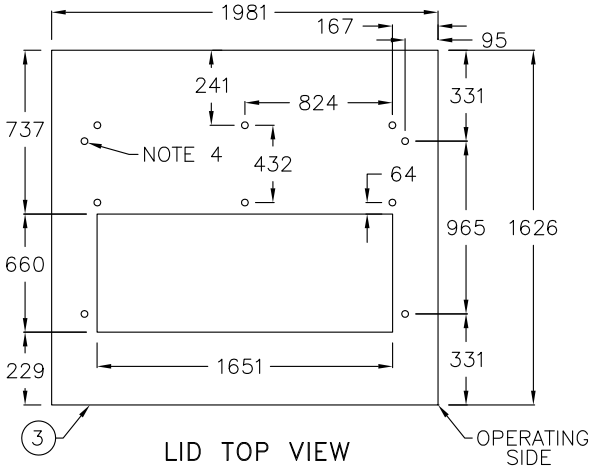
TYPICAL CONCRETE FOUNDATION - THREE PHASE CPP SWITCHGEAR (3-WAY)

Dwg. No. DU-09-402 Rev. 00

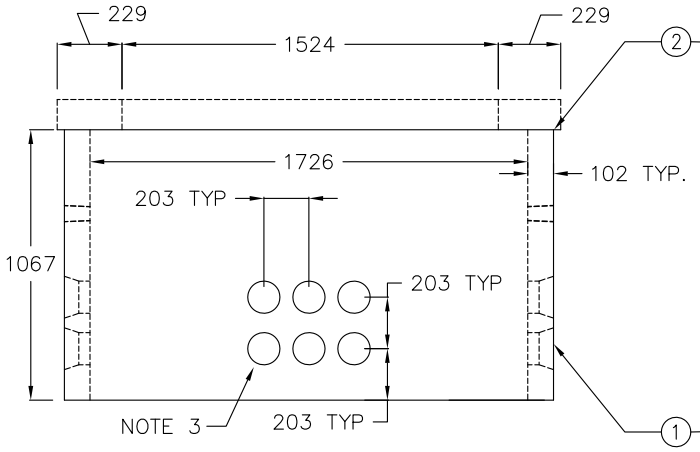


FOUNDATION TOP VIEW

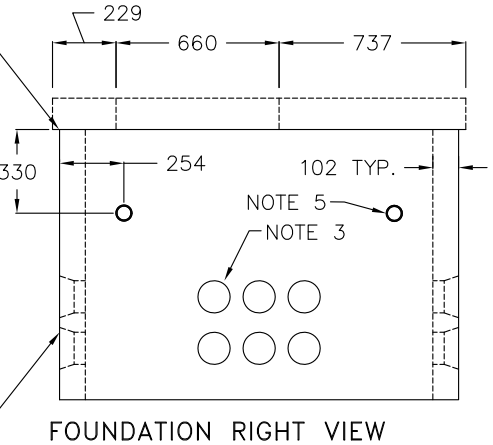




LID TOP VIEW



FOUNDATION FRONT VIEW



FOUNDATION RIGHT VIEW

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. APPROXIMATE MASS OF FOUNDATION IS 1590 kG.
3. CABLE ENTRY OPENINGS: PVC SEALS FOR 100mm DUCTS.
4. 1/2" N.C. PLASTIC THREADED INSERT.
5. 50mm LIFTING HOLE.
6. LID THICKNESS = 152mm, LID MASS = 550 kG.
7. USE PART #2 FOR ALL CPP THREE PHASE, 4-WAY SWITCHGEAR, EXCEPT FOR MODEL WITH RFI, USE PART #3.

PART #	MM #	DESCRIPTION	QTY.
1	N/A	CONCRETE FOUNDATION - BROOKLIN CONCRETE BCP 111 P (OR EQUIVALENT)	1
2	N/A	CONCRETE LID - BROOKLIN CONCRETE BCP 111 TGW H01 (OR EQUIVALENT)	1
3	N/A	CONCRETE LID - BROOKLIN CONCRETE BCP 111 TGW H02 (OR EQUIVALENT)	1

Rev. No.	Issue Date	Revision	Dwn	Approved By / Chk Date
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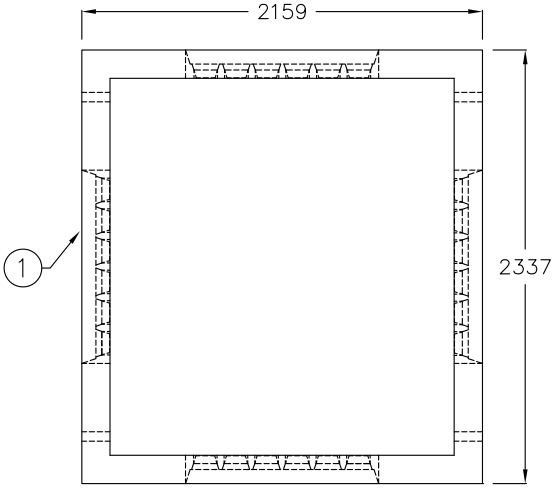
hydro one **Hydro One Networks Inc.**

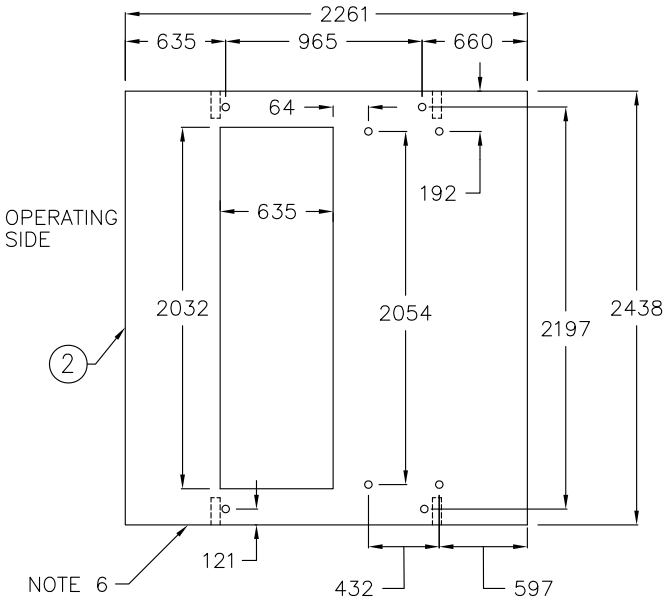
Drawn:	Approved:	Date:
S.OORT	*	NOV. 16, 2011

TYPICAL CONCRETE FOUNDATION - THREE PHASE CPP SWITCHGEAR (4-WAY)

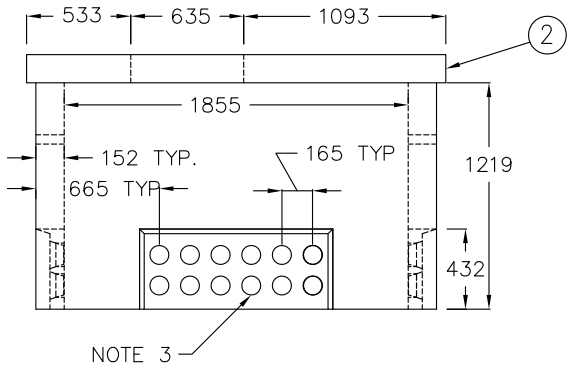
Dwg. No. DU-09-403 Rev. 00



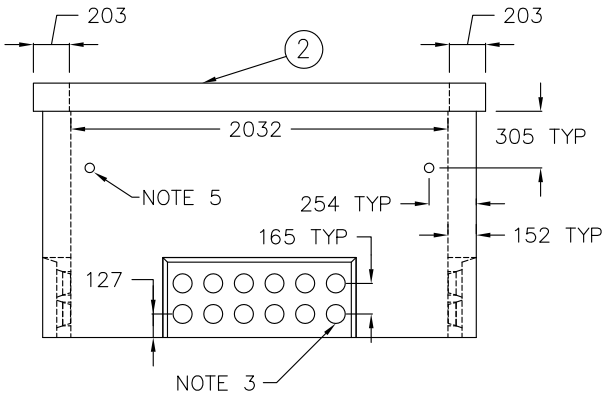
FOUNDATION TOP VIEW



LID TOP VIEW



FOUNDATION RIGHT VIEW



FOUNDATION FRONT VIEW

NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. APPROXIMATE MASS OF FOUNDATION IS 3450 kG.
3. CABLE ENTRY OPENINGS: PVC SEALS FOR 100mm DUCTS.
4. 1/2" x 2" N.C. PLASTIC THREADED INSERT.
5. 50mm LIFTING HOLE.
6. LID THICKNESS = 152mm, LID MASS = 1540 kG.

PART #	MM #	DESCRIPTION	QTY.
1	10009753	CONCRETE FOUNDATION – BROOKLIN CONCRETE BCP 400P (OR EQUIVALENT)	1
2	N/A	CONCRETE LID – BROOKLIN CONCRETE BCP 400TGW HO (OR EQUIVALENT)	1

Rev. No.	Issue Date	Revision	Dwn	Approved
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	*	*	Chk	By
				Date

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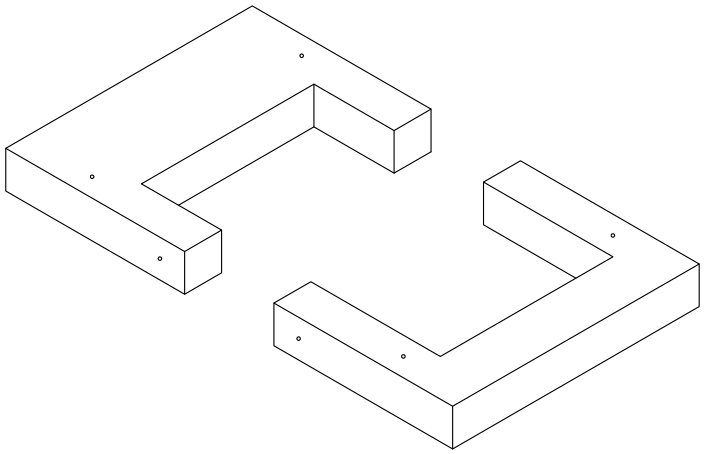
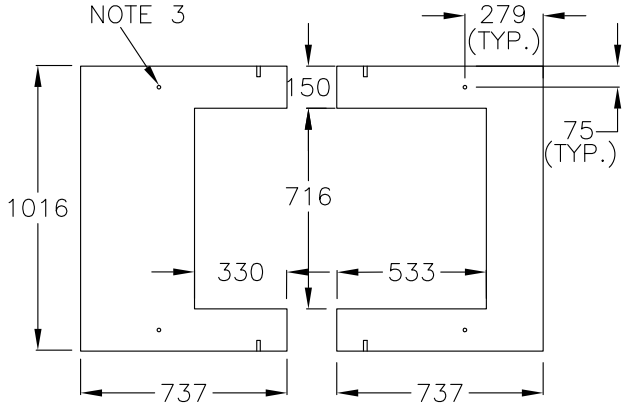
Drawn:	Approved:	Date:
S.OORT	*	NOV. 16, 2011

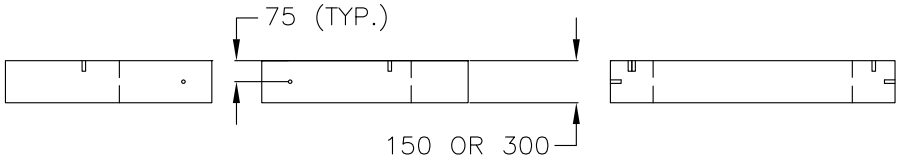
TYPICAL CONCRETE FOUNDATION - THREE PHASE CPP SWITCHGEAR (5-WAY)

Dwg. No. DU-09-404 Rev. 00

11/16/2011







NOTES:
1. ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.
2. APPROXIMATE MASS OF CONCRETE COLLAR IS 227/454Kg.
3. 1/2" X 2" N.C. PLASTIC THREADED INSERTS
4. TO BE USED WITH INSERVICE SINGLE–PHASE PAD–MOUNTED TRANSFORMERS USING A BROOKLYN CONCRETE PRODUCTS FOUNDATION ONLY WHEN 100mm GRADE SEPARATION HAS BEEN COMPROMISED.

THICKNESS	MM #	DESCRIPTION
150mm	10008614	PRECAST COLLAR FOR SINGLE PHASE TRANSFORMER FOUNDATION, BROOKLIN CONCRETE – BCP 110 TC6 OR EQUIVALENT
300mm	10009051	PRECAST COLLAR FOR SINGLE PHASE TRANSFORMER FOUNDATION, BROOKLIN CONCRETE – BCP 110 TC12 OR EQUIVALENT

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By Date
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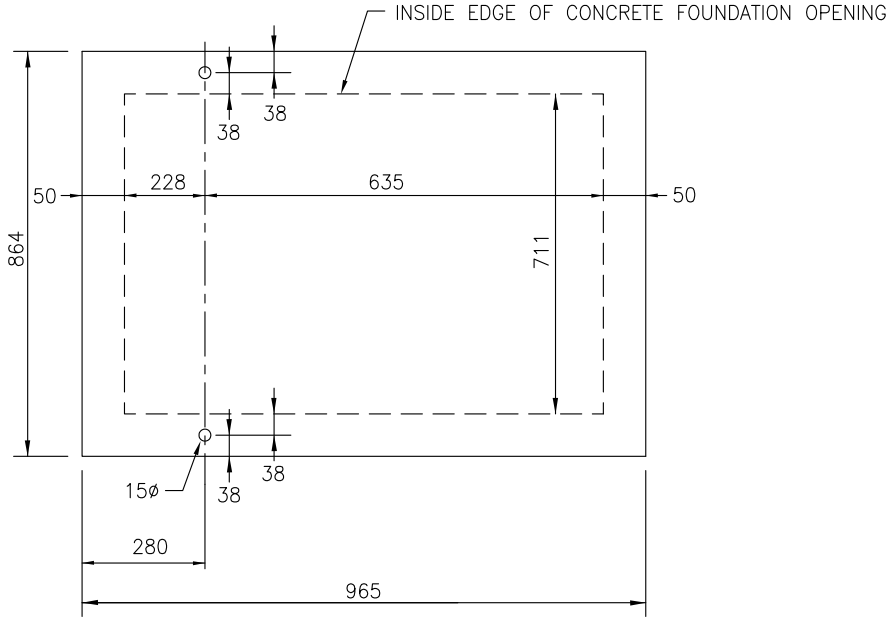
Drawn:	Approved:	Date:
MC	*	JAN. 27, 2009

PRECAST COLLAR FOR PAD-MOUNT GRADE ADJUSTMENT

Dwg. No. DU-09-501 Rev. 00



1/4" STEEL PLATE TO CSA GRADE G40.21–50G GALVANIZED AFTER FABRICATION COMPLETE WITH 2–5/8" ø HOLES AND 1/2"x1" BOLT WASHERS

NOTES:
1. DIMENSION TO FIT BCP 110 SERIES
   ADJUST ACCORDINGLY FOR OTHER MANUFACTURES UNITS.
2. DIMENSIONS ARE MILLIMETRES. UNLESS NOTED

CONVERSION TABLE	
METRIC (mm)	IMPERIAL (APPROX)
15mm	5/8"
38mm	1–1/2"
50mm	2"
228mm	9"
280mm	11"
635mm	25"
711mm	28"
864mm	34"
965mm	38"

Rev. No.	Issue Date	Revision	Dwn / Chk	Approved By / Date
*	* *	*	*	

hydro one **Hydro One Networks Inc.**

Drawn:	Approved:	Date:
P.CIARMOLI	*	JAN. 27, 2009

TEMPORARY STEEL COVER FOR SINGLE PHASE TRANSFORMER FOUNDATION

Dwg. No. DU-09-502 Rev. 00

SECTION 13
CABLE APPLICATION

Section 13-0
Cable Application

In this Section

This Section provides details of construction, installation and ampacity of UG cables as it relates to cable application.

SUB-SECTION 13-1
CABLE CONSTRUCTION

Section 13-1
Cable Construction

In this Section

This Section provides construction details of the UG cables. The construction details are representative only and there can be variations in dimension and weight due to tolerances allowed in the cable Standards.

Primary and sub transmission voltage cables used in the distribution system have 100% insulation level corresponding to maximum clearance time of 1 minute for phase to ground faults and continuous operating voltage not exceeding 105% of nominal voltage.

Submarine Cables 28 kV Cable Size AWG/KCM	**Construction**	**Conductor Diameter-mm**	**Diameter over Insulation-mm**	**Overall Diameter-mm**	**Weight kg/km**
1/0 AL	Solid	8.26	23.7	36.2	1795
2/0 Cu	Compact	9.55	26	47.4	3723
350 CU	Compact	15.72	31.75	52.35	5450
500 CU	Compact	18.77	34.54	56.67	6832
750 CU	Compressed	24.59	40.64	66.32	9932
1000 CU	Compressed	28.37	44.45	70.15	11890

Submarine Cables 44 kV Cable Size AWG/KCM	**Construction**	**Conductor Diameter-mm**	**Diameter over Insulation-mm**	**Overall Diameter-mm**	**Weight kg/km**
350 CU	Compact	15.72	41.15	65.53	6982
500 CU	Compact	18.77	44.2	68.55	8881
750 CU	Compressed	24.59	50.04	75.82	11365
1000 CU	Compressed	28.37	54.1	79.55	13366

Underground Cables 28 kV Cable Size AWG/KCM	**Construction**	**Conductor Diameter-mm**	**Diameter over Insulation-mm**	**Overall Diameter-mm**	**Weight-kg/km**
2/0 AL	Compact	9.55	24.96	32.81	1185
350 CU	Compact	15.65	31.8	40.27	3154
500 CU	Compact	18.69	34.54	45.29	4279
750 CU	Compressed	26.16	41.4	54.98	5951
1000 CU	Compressed	28.37	44.52	57.32	7958

Underground Cables 44 kV Cable Size KCM	Construction	Conductor Diameter-mm	Diameter over Insulation-mm	Overall Diameter-mm	Weight-kg/km
350 CU	Compact	15.65	41.15	54.77	4294
500 CU	Compact	18.69	43.77	57.41	5152
750 CU	Compact	23.06	47.4	60	6882
1000 CU	Compact	26.92	51.54	64.31	8669

Underground Cables 600V TRIPLEX Cable Size AWG/KCM	Construction	Conductor Diameter mm	Diameter over Insulation mm	Diameter over Jacket mm	Circumscribed Diameter Over 3 Cores	Weight kg/km
3/0 AL	Compact	10.74	13.44	15.58	33.57	1091
250 AL	Compact	13.21	16.25	19.29	41.57	1618
500 AL	Compact	18.69	21.94	25.18	54.26	2923

Underground Cables 600V QUADRUPLEX Cable Size AWG/KCM	Construction	Conductor Diameter mm	Diameter over Insulation mm	Diameter over Jacket mm	Circumscribed Diameter Over 3 Cores	Weight kg/km
3/0 AL	Compact	10.74	13.59	15.63	37.67	1412
250 AL	Compact	13.21	16.25	19.29	46.5	2157
500 AL	Compact	18.69	21.94	25.18	60.68	3897

SUB-SECTION 13-2
CABLE INSTALLATION AND TENSIONS

Section 13-2
Cable Installation

In this Section

This Section provides installation information and limitations of the UG cables.

Both Ends Neutral Grounding

The neutral of all secondary cables is always bonded to ground at each termination end of the cable section.

Generally, concentric neutral (CN) wires of primary and sub-transmission cables are bonded to ground at each termination end of the cable section. Due to this bonding to ground, induced circulating currents flow in the CN wires, producing heat, and resulting in reduced ampacity of such cables. Magnitude of this induced current is dependent on the total area of CN wires, current in the phase conductor, current in adjacent conductors of other cables, and spacing of other conductors.

Isolated Neutral

When required, to increase the ampacity of heavily loaded primary and sub-transmission cables, occasionally only one end of the CN of such a cable is bonded to ground and other end is isolated from ground using a 3 kV arrester.

This method of bonding has safety and other implications and its use should be very carefully reviewed. The isolated end of the CN will have the induced potential to ground under normal steady state as well as under fault and lightning conditions.

Due to limitations on the induced potential at the isolated CN end, the allowable length of such a cable section is limited and this length is mentioned in the cable ampacity tables section 13-3.

The smallest error in installation of such cables can be fatal to the cable. For example, if one or more strands of the isolated end of CN is accidently grounded, then induced current will flow in the CN and that coupled with the high normal load current of the cable (due to increased ampacity expectation) can heat up the cable beyond its acceptable limit and damage the cable insulation. Additionally, if the cable jacket is punctured during cable installation then the CN wire can be grounded through that punctured jacket and consequences will be similar to what is mentioned above.

Considering the above, it is strongly recommended that proper precautions be exercised in installation of such cables. It is expected that such an installation would occur only at the station egress feeder cables. For such station feeder cable installations, the station end of the cable CN will normally be isolated with 3 kV arrester and the OH line end of the cable section will be solidly bonded to ground.

An additional 350 kcmil Cu, 600V insulated ground continuity conductor (GCC) is required to be installed along the entire length of the isolated CN cable and it is preferable to transpose it midway between the three phase conductors as shown on drawing DU-13-301. This conductor is connected to ground at both ends of the cable section.

Cable Pulling Tensions

While pulling cables, the cable manufacturer recommended maximum-pulling tension and sidewall bearing pressure, for the type and size of the cable being pulled shall not be exceeded. If this information from manufacturer is not available, then the limits specified in Table 1 shall be observed. These limits are based on AEIC CG5 Publication "Underground Extruded Power Cable Pulling Guide."

TABLE 1

CABLE	RECOMMENDED MAXIMUM PULLING TENSION kN			RECOMMENDED MAXIMUM SIDEWALL BEARING PRESSURE kN/m OF BEND RADIUS
	PULL WITH PULLING EYE	PULL WITH PULLING GRIP		
		SINGLE CABLE	ONE GRIP ON THREE CABLES	
3/0 AL 600V TRIPLEX	11	n/a	8.9	11
250 KCM AL 600V TRIPLEX	17	n/a	8.9	11
500 KCM AL 600 V TRIPLEX	34	n/a	8.9	11
2/0 AL	4.6 *	n/a	n/a	29
2/0 CU	6.5	n/a	n/a	29
350 KCM CU	17 *	n/a	n/a	29
500 KCM CU	24 *	n/a	n/a	29
750KCM CU	36 *	n/a	n/a	29
1000 KCM CU	44 *	n/a	n/a	29

* single cable pull

Side wall bearing pressure limits are based on concrete encased conduits. For direct buried conduits reduce to 75% of the stated limits.

Cable Pulling Tensions

(cont.)

For calculating the expected tensions and side wall bearing pressures on cables as they are being pulled in ducts, the following simplified formulae can be used. For more complicated situations, refer to E&PD. As shown in the example below sometimes pulling the cables in reverse direction helps to reduce the tensions/sidewall bearing pressures.

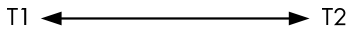
SIMPLIFIED FORMULAS FOR PULLING TENSION CALCULATIONS IN CONDUIT

Symbol	Description	Unit	Remarks
T1	Cable entrance tension	kN	
T2	Cable exit tension	kN	
R	Inside radius of duct bend	M	
W	Total weight per unit length of cable in duct	N/m	
θ	Angle of bend	radian	Radian= degree x (3.1416/180)
K	Dynamic Coefficient of friction Note: values shown in last column applies for straight pulls and bends with SWBP < 2175 N/M and in the presence of soap and water based lubricants.	dimensionless	PVC duct/PE jacket-0.4 PVC duct/PVC jacket – 0.5 PE duct/PE jacket- 0.25 PE duct/PVC jacket- 0.3
L	Length of cable in section	M	
SWBP	Sidewall bearing pressure	kN/m	
e	Base of natural logarithm	dimensionless	2.7183
Wc	Weight correction factor	dimensionless	1.0 for single cable in a conduit

Cable Pulling Tensions (cont.)

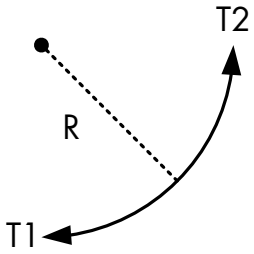
1) **Straight Horizontal Section Pull**

$T2 = T1 + WKWcL$ (1)



2) **Straight Horizontal Bend Pull**

$T2 = T1e^{(k)(Wc)(\theta)}$ for $0 < \theta < \Pi/2$ and $WR/T1 < 0.5$ (2)



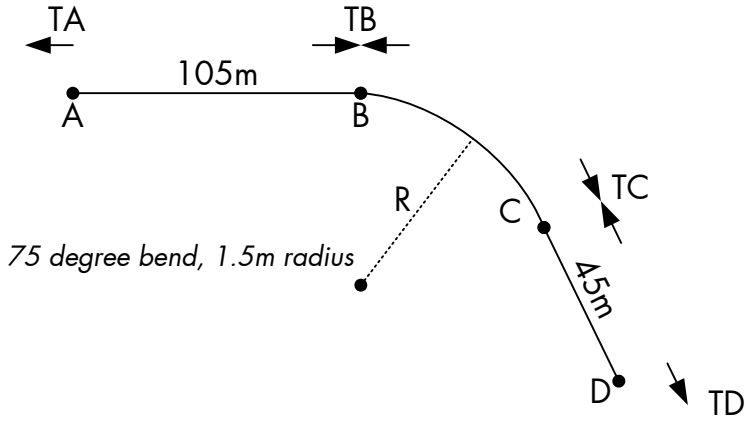
3) **Sidewall Bearing Pressure**

SBWP= T2/R Where T2 = Tension at cable bend exit calculated from 2) above.

Example:

Cable: 350 kcmil Cu, 28 kV 1/C cable - OD 44.15 mm, Weight 3.43 kg/m (33.61 N/m)
Conduit: 4 inch PVC min ID 100.1 mm
4 inch conduit 75 degree bend: radius of curvature 1500 mm
Duct layout:

- A- B : Straight section 105 m
- B- C: Horizontal 75 degree Bend
- C- D: Straight section 45 m



Assume tension at the beginning of the section as 200 N

Cable Pulling Tensions (cont.)

Calculations for straight pull from A to D

TA = 200 N

TB = TA + WKWcL = 200 + 33.61 x 0.4 x 1 x 105 = 1611.8 N

WR/TB = 33.61 x 1.5 / 1611.8 = .03 < 0.5 therefore the equation (2) above can be used.

TC = TB x $e^{(k)(Wc)(\theta)}$ = 1611.8 x $2.7183^{(0.4)(1)(1.309)}$ = 1611.8 x 1.6881 = 2720 N

SWBP = 2720/1.5 = 1813.33 N/m

TD = TC + WKWcL = 2720 + 33.61 x 0.4x1x 45 = 2720+ 604.98 = 3324 N

The expected maximum tension on cable when pulled from A to D is 3324 N and sidewall bearing pressure is 1813.33 N/m. Both are within the specified limits and therefore ok.

Calculations for reverse pull from D to A

TD = 200 N (beginning of the section)

TC = TD + WKWcL = 200 + 33.61 x 0.4x1x 45 = 805.05 N

WR/Tc = 33.61 x 1.5 / 805.05 = .062 < 0.5 therefore the equation (2) above can be used.

TB = TC x $e^{(k)(Wc)(\theta)}$ = 805.05 x $2.7183^{(0.4)(1)(1.309)}$ = 805.05 x 1.6881 = 1359 N

SWBP = 1359/1.5 = 906 N/m

TA = TB + WKWcL = 1359 + 33.61 x 0.4x1x 105 = 1359 +1411.62 = 2770.62 N

The expected maximum tension for pull from D to A is 2770.62 N and maximum sidewall bearing pressure of 906 N /m. Both these values are less than the corresponding values for a straight pull from A to D. Therefore, if practical, the cable should be pulled from D to A as it reduces the maximum tension and sidewall pressure on the cable.

Section 13-3
Cable Ampacity

In this Section

This Section provides information concerning the allowable ampacity of underground cables under defined installation conditions. Ampacity of submarine cables is listed in Section 6.

Purpose

The purpose of this section is to provide guidance in the form of basic design and installation conditions and the related ampacity of cables frequently used in new construction.

Single End Bonded Concentric Neutral For Ampacity Increase

In most applications, for safety reasons, the distribution cable concentric neutral (and armour, when present) will be bonded to the ground electrode at both ends of every cable section. In a small number of applications involving heavily loaded cables (to obtain higher ampacity), concentric neutral of a cable section may be bonded to ground at one end and isolated from ground at the other end. The advantage of the isolated neutral is that a smaller cable may be adequate for the load. It is recommended that such an application be restricted to station egress cables only. For cables that are exiting from a station, it is desirable that the isolated CN end be inside the station fence and grounded CN end on the pole outside the station. Isolation of the concentric neutral is achieved by connecting it to the line end of a 3 kV arrester.

This method of bonding has safety and other implications and is to be generally avoided. The isolated end of the CN will have the induced potential to ground under normal as well as under fault and lightning conditions. For a given cable section, this voltage is dependent on the cable loading, cable section length and spacing from other cables. HONI guide recommends that under normal steady state conditions this potential should not exceed 40V. When fault or lightning induced current flows through such a cable, it induces significantly high potential at the isolated end of the CN and this potential should not exceed what can be tolerated by 3 kV arrester as well as by the cable jacket. The worst case for the arrester occurs for single phase to ground fault.

Considering above, it is strongly recommended that due consideration should be given to other alternates before recommending single end bonded CN installation

An additional insulated ground continuity conductor (GCC) is recommended to be installed along the entire length of the isolated CN cable and it shall be transposed midway between the three phase conductors. This conductor is bonded to ground at both ends of the cable section. In the station this shall be bonded to the station medium/subtransmission system neutral and on egress pole outside the station this shall be bonded to the primary system neutral (if available on the egress pole). For 44 kV system, if there is no primary neutral on egress pole then this GCC should be bonded to the pole /arrester ground wire. Recommended size of this GCC is 350 kcmil, Cu, 600 V insulated. See drawing DU-13-301

Single End Bonded Concentric Neutral For Ampacity Increase(cont.)

Due to limitations on induced potential at the isolated CN end under normal conditions, allowable length of such a cable section is limited. Also this length is limited by the arrester power frequency TOV limit. The single phase to ground fault is the most severe condition for the arrester. Based on 10 kA single phase to ground fault current, the maximum permissible length is 118m for 28 kV 350 kcmil cable with 165 mm spacing between cables. Permissible length is inversely proportional to the single phase to ground fault current. There is very small increase in permissible length if spacing is reduced to 150 mm or if cable size is larger than 350 kcmil, but for practical purposes 118 m length should be considered for all sizes of cables up to 165 mm spacing and 10 kA fault current. For 20 kA single phase to ground fault current the permissible cable length will be halved. Longer lengths of several hundred meters are permissible under steady state conditions and under phase to phase fault conditions but generally the single phase to ground fault current is the limiting factor unless this single phase to ground current is very small compared to the steady state or p-p fault current. E&PD can be contacted for more guidance, if longer lengths are desired. The fault current mentioned is the one corresponding to the distance beyond the cable end.

It is recommended that wherever practical, the 3 kV arrester of single end bonded CN cables be inspected after every ground fault on feeder to ensure that the arrester is not damaged.

Single end bonded CN does not apply to submarine cables. These cables should always have both CN and armour ends bonded to ground.

DISTRIBUTION CABLES AMPACITY TABLES

Installation Conditions

Hydro One mostly uses generic parameter values for the surrounding area of the cable. The cable ratings are affected by the cable depth, soil thermal resistivity, soil thermal stability, solar radiation, ambient temperature, etc. In the absence of any specific information of these parameters, the generic parameters below can be assumed. Standards and New Technology/E&PD can be contacted for more specific calculations of ampacity, if parameters to be used are different from the ones given below.

- 50% return current through concentric neutral (CN) for single phase cable systems and no return current through CN for three phase cable systems.
- **Direct Buried**

  Earth thermal resistivity: 90°C centimeters per watt (°C cm/W)
  Ambient earth temperature: 20°C
  Load factor: 100% and 75%
  Conductor maximum operating temperature: 75°C for secondary and 90°C for primary and sub-transmission cables
  Concentric neutral (CN) grounding: Multipoint bonded and grounded OR single end bonded
  Burial depth in the earth: 900 mm (36”) to top of the cable
  Cable spacing: 165 mm (6.5”) center to center, horizontal, for primary and sub- transmission cables, and 100 mm (4”) for secondary cables.
  Primary/sub-transmission to secondary cables horizontal spacing 165 mm (6.5”)
  Vertical spacing 165 mm (6.5”), center to center
  Note:
  1. Load Factor is the ratio of the average load to the maximum load, in percentage, over a specified (usually 24 hrs) time period.

- **Direct Buried Duct**

  Earth thermal resistivity: 90°C centimeters per watt (°C cm/W)
  Ambient earth temperature: 20°C
  Load factor: 100% and 75%
  Conductor maximum operating temperature: 75°C for secondary and 90°C for primary and sub-transmission cables
  Concentric neutral (CN) grounding: Multipoint bonded and grounded OR single end bonded
  Burial depth in the earth: 750 mm (30”) to top of the duct
  Duct spacing: 165 mm (6.5”) centre to centre for primary and sub-transmission cables, ducts touching each other for secondary cables
  Vertical spacing 165 mm (6.5”), center to center

Conduit(duct) diameter

100 mm ID conduit for up to 750 kcm 28 kV cables and for up to 500 kcm 44 kV cables.

125 mm ID conduit for 1000 kcm 28 kV cables and for 750 kcm and 1000 kcm 44 kV cables.

- **Concrete Encased Duct Bank**

Earth thermal resistivity: 90°C centimeters per watt (°C cm/W)
Concrete thermal resistivity: 50°C centimeters per watt (°C cm/W)
Ambient earth temperature: 20°C
Load factor: 100% and 75%
Conductor maximum operating temperature: 75°C for secondary and 90°C for primary and sub-transmission cables
Concentric neutral (CN) grounding: Multipoint bonded and grounded OR single point bonded
Burial depth in the earth: 750 mm (30") to top of the concrete duct bank.
Duct spacing: 165 mm (6") centre to centre vertically and horizontally.
Multiple circuits stacked vertically one above the other@165 mm spacing

Conduit(duct) diameter

100 mm ID conduit for up to 750 kcm 28 kV cables and for up to 500 kcm 44 kV cables.

125 mm ID conduit for 1000 kcm 28 kV cables and for 750 kcm and 1000 kcm 44 kV cables.

- **Cable in Unventilated Riser in Air**

Ambient air temperature: 40°C and 0°C
Solar effect: 700 W/m^2 (65 W/ft^2)
Wind speed: No wind.
Notes:

1. 0°C rating is provided for use in some areas where peak load occurs during winter months. In general the riser cable ampacity will be the limiting ampacity for any given cable when riser length is greater than 3 m.
2. For cable sections where riser length is less than 10% of the cable section length (maximum 3 m), the riser portion can be neglected for ampacity purpose.
3. For riser conduit/guard size see table 11

SUB-SECTION 13-4
SECONDARY AND SERVICE CABLE APPLICATION DATA

Section 13-4

Secondary and Service Cable Application Data

Table 1
Sizes of U/G Service Wire for 120/240 V Services

Max Demand		Length of Service Including Risers m																	
		15	23	30	38	46	53	61	69	76	84	92	100	108	116	124	132	140	150
Amps	**kVA**	**Recommended Size of Cable for 120/240V Services**																	
21	5.0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	250 250	250 250	250 250	250 250	250 250	250 250
31	7.5	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 250	3/0 250	3/0 250	250 500	250 500	250 500	250 500	250 500	250 500
42	10.0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 250	3/0 250	3/0 250	3/0 500	3/0 500	3/0 500	250 500	250 500	250 500	250 500	250 ---	250 ---
52	12.5	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 250	3/0 250	3/0 500	3/0 500	3/0 500	3/0 500	3/0 500	250 500	250 500	250 ---	250 ---	250 ---	250 ---
60	14.4	3/0 3/0	3/0 3/0	3/0 3/0	3/0 3/0	3/0 250	3/0 250	3/0 500	3/0 500	3/0 500	3/0 500	3/0 500	3/0 ---	250 ---	250 ---	250 ---	250 ---	250 ---	250 ---
70	16.8	3/0 3/0	3/0 3/0	3/0 3/0	3/0 250	3/0 500	3/0 500	3/0 500	3/0 500	3/0 500	3/0 ---	3/0 ---	3/0 ---	250 ---	250 ---	250 ---	250 ---	250 ---	250 ---
80	19.2	3/0 3/0	3/0 3/0	3/0 3/0	3/0 250	3/0 500	3/0 500	3/0 500	3/0 500	3/0 ---	3/0 ---	3/0 ---	3/0 ---	250 ---	250 ---	250 ---	250 ---	250 ---	250 ---
90	21.6	3/0 3/0	3/0 3/0	3/0 250	3/0 500	3/0 500	3/0 500	3/0 500	3/0 ---	3/0 ---	3/0 ---	3/0 ---	3/0 ---	250 ---	250 ---	250 ---	250 ---	250 ---	500 ---
100	24.0	3/0 3/0	3/0 3/0	3/0 250	3/0 500	3/0 500	3/0 500	3/0 ---	3/0 ---	3/0 ---	3/0 ---	3/0 ---	250 ---	250 ---	250 ---	250 ---	500 ---	500 ---	500 ---
120	28.8	3/0 3/0	3/0 250	3/0 500	3/0 500	3/0 500	3/0 ---	3/0 ---	3/0 ---	3/0 ---	250 ---	250 ---	250 ---	500 ---	500 ---	500 ---	500 ---	500 ---	500 ---
150	36.0	3/0 3/0	3/0 500	3/0 500	3/0 500	3/0 ---	3/0 ---	3/0 ---	250 ---	250 ---	250 ---	500 ---	500 ---	500 ---	500 ---	500 ---	500 ---	500 ---	500 ---
160	38.4	3/0 3/0	3/0 500	3/0 500	3/0 ---	3/0 ---	3/0 ---	250 ---	250 ---	250 ---	500 ---	500 ---	500 ---	500 ---	500 ---	500 ---	500 ---	500 ---	--- ---

Note: The upper number is the size of service conductor if fed directly from a transformer. The lower number is the size of the service conductor fed from a bus. The direct to transformer connection allows a voltage drop of 4 volts while only 1 volt is allowed from buses. All cable is 3 conductor twisted secondary aluminum underground.

Maximum Runs

Maximum length of 3/0 underground cable is 100m and max length for 250mcm and 500mcm underground cable is 150m. Maximum service conductor size to be terminated in a 200A meter base is 250mcm.

Service Loads

For service loading follow the method outlined in Section 11-2-2 of the Overhead Distribution Standards "Determining Size of Triplex Service Taps"

SECTION 16
MATERIALS

Section 16-0
Materials

General

This section consists of a list containing the description and MM# of the Hydro One approved materials for use with the Underground Distribution Standards.

In This Section

This section is divided into two subsections;

Topic	Section #
Key Word Index	16-1
Reference List by Material Name	16-2

SUB-SECTION 16-1
KEY WORD INDEX

Section 16-1
Key Word Index

SUB-SECTION 16-2
REFERENCE LIST BY MATERIAL NAME

Section 16-2

Reference List by Material Name

ARRESTER

Surge

Description	MM#
ARRESTER, INTERMEDIATE, 48kV, 39 kV MCOV	10000230

Riser Pole

Description	MM#
ARREST DIST-6KV-5.1KVMCOV-RISER POLE	30014652
ARREST DIST-9KV-7.65KVMCOV-RISER POLE	30014651
ARREST DIST-18KV-15KVMCOV-RISER POLE	30014650
ARREST DIST-21KV-17.2KVMCOV-RISER POLE	30014649

Bushing

Description	MM#
ARREST DIST-21KV-17KVMCOV-BUSHING	30005599

Elbow

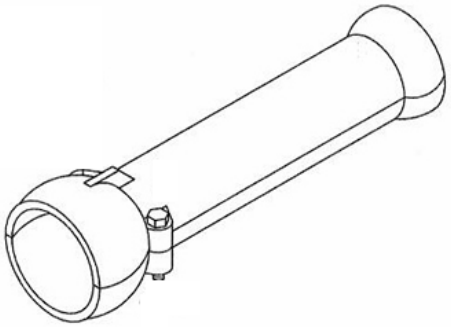
Description	MM#
ARREST DIST-21KV-17KVMCOV-ELBOW	30005598

Parking Stand

Description	MM#
ARREST DIST-6KV-5.1KVMCOV-PK STD	30009905
ARREST DIST-21KV-17KVMCOV-PK STD	30005604

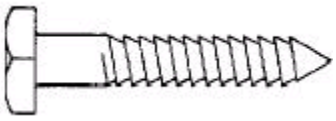
ARTICULATED PIPES

Description	MM#
PROTECTOR SHELL ARTICULATED PIPE, PART NUMBER PS055/500/09 OR EQUIVALENT	To be determined
PROTECTOR SHELL ARTICULATED PIPE, PART NUMBER PS076/475/09 OR EQUIVALENT	To be determined
PROTECTOR SHELL ARTICULATED PIPE, PART NUMBER PS120/460/09 OR EQUIVALENT	To be determined
PROTECTOR SHELL DOGBONE/TENSION CLAMP FOR ARTICULATED PIPE, PART NUMBER PS055/500/09 OR EQUIVALENT	To be determined
PROTECTOR SHELL DOGBONE/TENSION CLAMP FOR ARTICULATED PIPE, PART NUMBER PS076/475/09 OR EQUIVALENT	To be determined
PROTECTOR SHELL DOGBONE/TENSION CLAMP FOR ARTICULATED PIPE, PART NUMBER PS120/460/09 OR EQUIVALENT	To be determined
PROTECTOR SHELL SADDLE CLAMP FOR ARTICULATED PIPE, PART NUMBER PS055/500/09 OR EQUIVALENT	To be determined
PROTECTOR SHELL SADDLE CLAMP FOR ARTICULATED PIPE, PART NUMBER PS076/475/09 OR EQUIVALENT	To be determined
PROTECTOR SHELL SADDLE CLAMP FOR ARTICULATED PIPE, PART NUMBER PS120/460/09 OR EQUIVALENT	To be determined



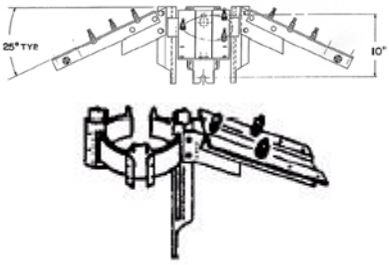
BOLT

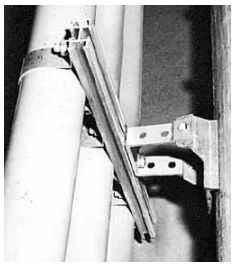
Description	MM#
BOLT HEX HEAD-1/2IN-1-1/2IN LG-SI BR	30001184
BOLT HEX HEAD-1/2IN-2IN LG-SN BR	30001185
BOLT HEX HEAD-3/8IN-1-1/2IN LG-SI BR	30001181
BOLT HEX HEAD-GR2-9.5MM-38.10MM LG-GALV	30001243
BOLT HEX HEAD-GR2-1/2MM-1-3/4MM LG-GALV	30001353
BOLT HEX HEAD-GR2-12.4MM-38.1MM LG-GALV	30001137
BOLT HEX HEAD-GR2-12.7MM-25.4MM LG-GALV	10000081
BOLT LAG -1/4"DIA-2-1/2"LG-GALV	30001989
BOLT LAG CONE -3/8"DIA-4"LG-GALV	30001777

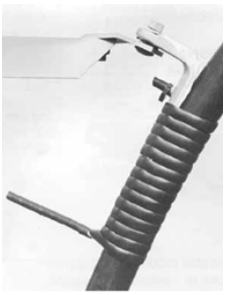


BRACKET AND SUPPORT

Description	MM#
BRACKET, MOUNTING, CABLE & ARRESTER, ALUMA-FORM 3IAP, CLUSTER MOUNT	30000846
BRACKET, MOUNTING, CABLE, ALUMA-FORM 1IAP, SINGLE MOUNT	10000049
BRACKET, CONDUIT STAND-OFF	30009335
BRACKET-CUTOUT/ARRESTER-SINGLE PHASE-	30000825
STRAP, BRACKET, CONDUIT STAND-OFF	30009336
SUPPORT,FOR CBL & TERMINATION	30008041



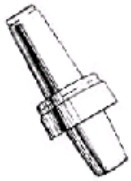


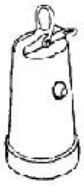


BUSHING & ACCESSORIES

Loadbreak Bushings

Description	MM#
BUSHING, STANDOFF, PARKING, LOADBRK-15KV-200A	30006645
BUSHING, INSERT, LOADBRK-15KV-200A-	30007437
BUSHING, INSERT, LOADBRK-28KV-200A-	30007479
BUSHING, STANDOFF, PARKING, LOADBRK-28KV-200A	30007492
PLUG, GROUNDING, 28KV-200A	30007493
FEEDTHR, DOUBLE INSERT, LOADBRK-15KV-200A	30014608
BUSHING, DOUBLE INSERT, LOADBRK-28KV-200A	30010601





Insulating Caps

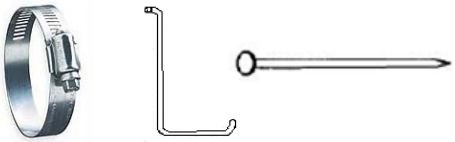
Description	MM#
CAP INSULATING-15KV-200A-	30007438
CAP INSULATING-28KV-200A-	30007478
CAP INSULATING-28KV-600A-	30017838

Feedthrough

Description	MM#
FEEDTHR, PORTABLE, LOADBRK-15KV-200A	30007439
FEEDTHR, PORTABLE, LOADBRK-28KV-200A	30007480

CLAMP

Description	MM#
CLAMP, GEAR TYPE, SSTL, 2-13/16 to 3-3/4”	30003502
CLAMP, POLE REST, NAIL, 8" LG,DAIM PT	30000777
CLAMP REST, INSULATOR TYPE, 2/0 CU	30000770



CONDUCTOR, BARE

Description	MM#
COND BARE COPPER -4AWG-SOLID-SD	30005813
COND BARE COPPER -4AWG-STRD-SD	30014480
COND BARE COPPER -1/0AWG-STRD-MHD	30005821
COND BARE COPPER -2/0AWG-STRD-MHD	30005823
COND BARE COPPER -4/0AWG-STRD-MHD	30005825

CONDUCTOR, INSULATED, 600 V

Description	MM#
CABLE, 3/0AWG-3 COND-600V	30005908
CABLE, 4/0AWG-3 COND-600V	30006112
CABLE, 250KCMIL-3 COND-600V	30005915
CABLE, 500KCMIL-3 COND-600V	30005959

CONDUCTOR, INSULATED, 28 kV

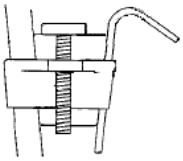
Description	MM#
CABLE, UGRND -28KV-2/0AWG-AL	30010134
CABLE, UGRND -28KV-350KCMIL-CU	30006080
CABLE, UGRND -28KV-500KCMIL-CU	30006082
CABLE, UGRND -28KV-750KCMIL-CU	30006083
CABLE, UGRND -28KV-1000KCMIL-CU	30006085
CABLE, SUBMARINE-1/0, 28 kV, SOLID ALUMINUM, POLYETHYLENE COVERED COPPER CLAD STEEL WIRE ARMOUR	30024485
CABLE, SUBMARINE -28 kV-2/0-CU	30006090
CABLE, SUBMARINE -28 kV-350 KCMIL-CU	30006092

CONDUCTOR, INSULATED, 46 kV

Description	MM#
CABLE, UGRND -46KV-350KCMIL-CU	10000252
CABLE, UGRND -46KV-500KCMIL-CU	30013173
CABLE, UGRND -46KV-750KCMIL-CU	30006084
CABLE, UGRND -46KV-1000KCMIL-CU	30006086
CABLE, SUBMARINE-46 kV-350 KCMIL	30006094
CABLE, SUBMARINE-46 kV-1000 KCMIL	30006095

CONNECTOR

Ground Rod



Description	MM#
CONN-TAP WEDGE AMP-4 AWG-3/4GRD ROD	30006646
CONN-TAP WEDGE AMP-1/0 AWG3/4GRD ROD	30021037

CONNECTOR

Live Line

Description	MM#
CONN LIVE LINE-CU-#2-19.5mm LINE-2/0 to 4/0AWG TAP, 400A Max	30007392
CONN LIVE LINE-CU-#8 – 2/0	30006195
CONNECTOR, LIVE LINE, STUD, PIGTAIL, 600A	30006969

CONNECTOR

Junction Block

Description	MM#
CONN, TAP BOLTED, 14 PORTS,4 AWG-250KCMIL COND,STRAIGHT, FOR PADMOUNT TRANSFORMER	30013232
CONN, INSUL 600V,8 POSITIONS, 4AWG-500KCMIL	30007467

CONNECTOR

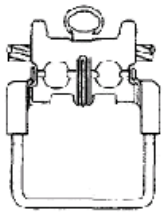
Split Bolt

Description	MM#
CONN-SPLIT BOLT-CU-8-2AWG-STRAND	30007270
CONN-SPLIT BOLT-CU-6-2AWG-STRAND	30006154

CONNECTOR

Stirrup

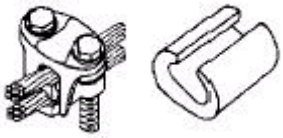
Description	MM#
CONN STIRRUP-BAIL-#2-4/0AWG- ACSR	30006184
CONN STIRRUP-BAIL-336.4/556.5 KCM ASC	30006968



CONNECTOR

Tap

Description	MM#
CONN-TAP BLTD COND2COND-CU-1/0-4/0 -8-4/	30006155
CONN-TAP COMP-CU-4AWG-	30006509



CONNECTOR, TERMINAL

Bolted

Description	MM#
CONN-TERM BLTD PAD-AL TND-350-800KCMIL-	30007244
CONN-TERM BLTD PAD-AL TND-4/0-500KCMIL-	30007239
CONN-TERM BLTD PAD-AL TND-6AWG-250KCMIL-	30007238
CONN-TERM BLTD PAD-CU TND-2X6AWG-1HOLE	30007272
CONN-TERM BLTD PAD-CU-1/0-4/0AWG-1HOLE	30006145
CONN-TERM BLTD PAD-CU-4-1/0AWG-1HOLE	30006144

CONNECTOR, TERMINAL

Compression

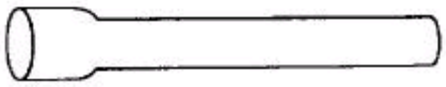
Description	MM#
CONN-TERM COMP PAD-4/0AWG-1X12MM HOLE-	30006710
CONN-TERM COMP PAD-4AWG-1X12MM HOLE-	30006788
CONN-TERM COMP PAD-2AWG-1X14MM HOLE-	30006431
CONN-TERM COMP PAD-AL-250KCMIL-2XM12 STU	30006461
CONN-TERM COMP PAD-AL-500KCMIL-2X14MMHO	30006462

CUTOUT

Description	MM#
FUSE CUTOUT,OPEN-15KV-200A-110KVBIL	30005716
FUSE CUTOUT,OPEN-27KV-100A-125KVBIL	30005713
FUSE CUTOUT,OPEN-28KV-200A-125KVBIL	30005715

DUCT AND ACCESSORIES

Description	MM#
BEND,PVC DUCT,4X36" RADIUS,90DEG,PLAIN	30003291
DUCT,PVC,2"DIAX10' LG,BELL ENDS,DB2	30007711
DUCT,PVC,3"DIAX10' LG,BELL ENDS,DB2	30007709
DUCT,PVC,4"DIAX10' LG, BELL ENDS,DB2	30007710
SPACER,DUCT SADDLE,4" DUCT,3"SPACE	30003513
SPACER,DUCT SADDLE,4"DUCT,2"SPACE	30003514
CONDUIT, FLEX, 2”, CARLON	30026617



ELBOW

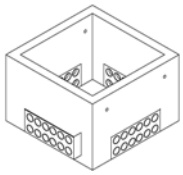
Description	MM#
ELBOW LOADBREAK 28 kV, 200 AMP, 1/0 AWG W/TEST POINT	30007475
ELBOW,LOADBRK-28KV-200A-2/0AWG W TEST PT	30007476
ELBOW,DEADBRK-28KV-600A-350KCMIL	30014211
DEAD/LOADBRK, REDUCE PLUG,28kV,600/200A	30017000

FAULTED CIRCUIT INDICATOR (FCI)

Description	MM#
INDICATOR, FCI 300A,O/H&UG APP MECHANICAL TYPE	30013112
INDICATOR, FCI, ONE CABLE, BATTERY	30018800
INDICATOR, FCI, THREE CABLES BATTERY	30022812

FOUNDATION

Description	MM#
FDNT, ALUM BASE For 25kVA Micropad/Ranchrunner	30011213
FDNT, ALUM BASE For 25-50kVA Padmount Transformer	30011214
FDNT, ALUM BASE (Sustainment Purposes – Single Phase Kabar Kiosk)	30011215
BCP 110PC For Single Phase Padmount Transformer	30013011
BCP-110PS W/ GALV PLATE (Sustainment Purposes – Single Phase Kabar Kiosk)	30012998
BCP 110TC6, CONCRETE COLLAR Used when 100mm grade separation is compromised	10008614
BCP 110TC12, CONCRETE COLLAR Used when 100mm grade separation is compromised	10009051
BCP 111P, BCP 111TGW, and BCP 111B For CPP 3Ø(4Way) Switchgear	30018165
BCP 114B For use with BCP 114P in poor soil conditions	10009281
BCP 114P, BCP114T6 For Three Phase Padmount Transformer (<500 kVA)	30013789
BCP 400P For CPP 3Ø(5Way) Switchgear (Foundation)	10009753
BCP 400T6GW For CPP 3Ø(5Way) Switchgear (Top)	10009752



FUSE

Description	MM#
FUSE H.V. C/L-23KV-25A--CANISTER-	30005674
FUSE H.V. C/L-23KV-18A--CANISTER-	30005675
FUSE H.V. C/L-23KV-8A--CANISTER-	30005676
FUSE H V C/L-23KV-6A-KA-CANISTER-	30005694
FUSE H V C/L-23KV-12A-KA-CANISTER-	30005695
FUSE H V-14.4KV-100A-14KA-SMU20	30014154

GRIP CABLE SUPPORT

Description	MM#
GRIP CABLE SUPPORT -1.0"-1.24"	10011801
GRIP CABLE SUPPORT -1.25"-1.49"	10011802
GRIP CABLE SUPPORT -1.50"-1.74"	10011803
GRIP CABLE SUPPORT -1.75"-1.99"	10011804
GRIP CABLE SUPPORT -2.00"-2.49"	10011805
GRIP CABLE SUPPORT -2.50"-2.99"	10011806
GRIP CABLE SUPPORT -3.00"-3.49"	10011807

GROUND ENHANCING MATERIAL (GEM)

Description	MM#
GROUND ENHANCING MATERIAL	30025402

GROUND PLATE

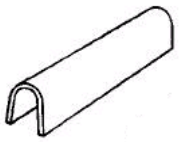
Description	MM#
GALVANIZED STEEL PLATE, COMPLETE WITH 0.25m X 0.40 m X 0.006 m (10” X 16” X ¼”) GROUND PLATE AND GROUND ROD STUB	30025401

GROUND ROD

Description	MM#
ROD,GROUND,3/4" X 10 FT, GALV	30014142

GUARD AND MOULDING

Description	MM#
GROUND WIRE MOULDING-8' LG-WOOD	30000053
GUARD,CABLE,AL OR GALV STEEL,80MMX2.4M	30000732
GUARD,CABLE,60MMX2.5M,ALUM OR STEEL,	30000733
GUARD,CABLE,30MM X 2500MM STEEL OR ALUM	30000871
GUARD,CABLE,100MMX2.5M,ALUM OR STEEL	30000897



INSULATOR, STANDOFF

Description	MM#
INSULATOR,STAND-OFF,POLYMERIC, 28 kV	30008425
INSULATOR,STAND-OFF,POLYMERIC, 44 kV	10000412

KIOSK

Single Phase

Description	MM#
1Ø, 3-way, 15 kV	30010815
1Ø, 4-way, 15 kV	30011283
1Ø, 3-way, 28 kV	30011280
1Ø, 4-way, 28 kV	30011101

Three Phase

Description	MM#
3Ø, 3-way, 15 kV	30011246
3Ø, 4-way, 15 kV	30011260
3Ø, 3-way, 28 kV	30014366
3Ø, 4-way, 28 kV	30010863

LUBRICANT AND SEALANT

Description	MM#
SEALANT, COMPOUND DUCT SEALING 5 LB	30009051
LUBRICANT, CP CABLE PULLING 5 GAL PAIL	30009052

MARKER, SIGN AND NUMBER

Numbers

Description	MM#
MARKER, NBR 1 ADHESIVE SILVER 127MM	20001635
MARKER, NBR 2 ADHESIVE SILVER 127MM	20001636
MARKER, NBR 3 ADHESIVE SILVER 127MM	20001637
MARKER, NBR 4 ADHESIVE SILVER 127MM	20001638
MARKER, NBR 5 ADHESIVE SILVER 127MM	20001639
MARKER, NBR 6 ADHESIVE SILVER 127MM	20001640
MARKER, NBR 7 ADHESIVE SILVER 127MM	20001641
MARKER, NBR 8 ADHESIVE SILVER 127MM	20001642
MARKER, NBR 9 ADHESIVE SILVER 127MM	20001643
MARKER, NBR 0 ADHESIVE SILVER 127MM	20001644
MARKER, NBRS POLYMER 32 MM NO 1	20001792
MARKER, NBRS POLYMER 32 MM NO 2	20001793
MARKER, NBRS POLYMER 32 MM NO 3	20001794
MARKER, NBRS POLYMER 32 MM NO 4	20001795
MARKER, NBRS POLYMER 32 MM NO 5	20001796
MARKER, NBRS POLYMER 32 MM NO 6 or 9	20001797
MARKER, NBRS POLYMER 32 MM NO 7	20001798
MARKER, NBRS POLYMER 32 MM NO 8	20001799

Phase

Description	MM#
MARKER, PHASE P/S RED 3 1/8" DIAMETER	20001694
MARKER, PHASE P/S WHITE 3 1/8" DIAMETER	20001695
MARKER, PHASE P/S BLUE 3 1/8" DIAMETER	20001696

Miscellaneous Signs

Description	MM#
SIGNS, STAKE, MARKER, U/G CBL,STL STAKE	10000425
SIGN CAUTION MARKER CAUTION LOOP FEED	20001595
MARKER, U/G CABLE (SCREW IN TYPE)	20001630
SIGN DANGER, MARKER DANGER DO NOT ENERG	20002006
SIGN DANGER, DO NOT OPEN YOU CAN BE HURT	20002119
SIGN DANGER DO NOT DIG OR DRIVE STAKES	20002125
SIGN DANGER, MARKER DANGER HIGH VOLTAGE	20002130
SIGN CAUTION BURIED ELECTRIC LINE	20002181
SIGN CAUTION MARKER DO NOT OPERATE FUSE	20002182
SIGNS, STAKE, MARKER, U/G CBL,STL STAKE, Steel 38mm x 1525mm	10000425
WARNING SIGN PLATE (340x450) – "STAY CLEAR – HIGH VOLTAGE CABLE"	To be determined

Sign Accessories

Description	MM#
GROUT FOR ROCK ANCHOR	30013957

NEUTRAL ISOLATOR

Description	MM#
NEUTRAL ISOLATOR - BRPRT-SWITCH, ELECTRONIC, PRIMARY AND SEC	30021907

NUT

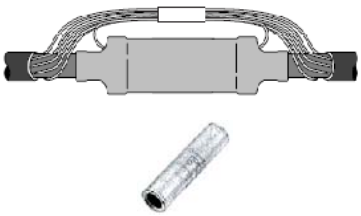
Description	MM#
NUT-HEX-3/8"-SIL BR-FINISHED-2B UNC	30001498
NUT-HEX-1/2"-SIL BR-FINISHED-2B UNC	30001499

PADLOCK

Description	MM#
PADLOCK, BRASS 5 PIN TUMBLER 50 MM CASE	30000346

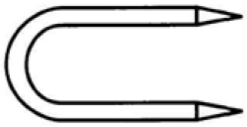
SPLICE

Description	MM#
SPLICE KIT, 28KV-2/0AWG-COLD SHRINK	30008012
SPLICE KIT, 28KV-350KCMIL-COLD SHRINK	30008020
SPLICE KIT, 28KV-500KCMIL-COLD SHRINK	30008022
SPLICE KIT-28KV-750KCMIL-COLD SHRINK	30017197
SPLICE KIT-46KV-500KCMIL-COLD SHRINK	30019505
SPLICE KIT-46KV-750KCMIL-COLD SHRINK	30016917
SPLICE KIT-46KV-1000KCMIL-COLD SHRINK	30017255
SPLICE KIT, 28KV-1/0 AWG SOLID AL SUBMARINE CABLE	30019268
SPLICE KIT, 46KV-350KCMIL SUBMARINE CABLE, COLD SHRINK	10011691
SPLICE KIT, 600V, 500KCMIL AL, CONNECTOR AND COLD SHRINK SPLICE TUBE	30006397 & 30013875
SPLICE KIT, 600V, 250KCMIL AL, CONNECTOR AND COLD SHRINK SPLICE TUBE	30006455 & 30008346
SPLICE KIT, 600V, 3/0 AL, CONNECTOR AND COLD SHRINK SPLICE TUBE	30008346 & 30006695
GMP TOOLS SUBMARINE SPLICER CASE FOR 51 mm (2 in) O.D CABLE, PART NUMBER 75662	To be determined
GMP TOOLS SUBMARINE SPLICER CASE FOR 76 mm (3 in) O.D CABLE, PART NUMBER 75663	To be determined
GMP TOOLS SUBMARINE SPLICER CASE FOR 102 mm (4 in) O.D CABLE, PART NUMBER 75664	To be determined



STAPLE

Description	MM#
STAPLE, GENERAL USE GALV, 3" LG, 5/8" W	30001735
STAPLE,GRD WIRE GALV,1-1/2" LG,3/8" W	30013881



STRAP

Description	MM#
STRAP,CABLE,AL OR GALV STEEL,60 MM	30000744
STRAP,CABLE,AL OR GALV STEEL,30 MM	30000745
STRAP,CABLE,AL OR GALV STEEL,80 MM	30000746
STRAP,CABLE,GUARD, 100 MM	30000923

SWITCHGEAR

Single Phase

Description	MM#
SWG,SOLID INS,1Ø,28KV,1X200SW,3X200RFI	30020254
SWG,SOLID INS,1Ø,28KV,4X200SW	10009881

Three Phase

Description		MM#
3-Way	SF6 SWITCH/RFI, 3-WAY-PADMOUNT, C/W(2) 3	30017712
4-Way	SWG,SF6,3Ø,15KV,1X600GSW,3X200GSW	10009882
	SWG,SF6,3Ø,15KV,2X600GSW,2X200GSW	10009883
	SWG,SF6,3Ø,15KV,2X600GSW,2X200GRFI	10009884
	SWG,SF6,3Ø,15KV,2X600GSW,6X200-1ØRFI	10009885
	SWG,SF6,3Ø,15KV,2X600GSW,6X200-1ØSW	10009886
	SWG,SF6,3Ø,15KV,4X200GSW	10009887
	SWG,SF6,3Ø,15KV,6X200-1ØSW,6X200-1ØRFI	10009888
	SWG,SF6,3Ø,15KV,2X200GSW,6X200-1ØSW	10009889
	SWG,SF6,3Ø,15KV,4X600GSW	10009890
	SWG,SF6,3Ø,28KV,2X600GSW,2X200GRFI	10009895
	SWG,SF6,3Ø,28KV,2X600GSW,6X200-1ØRFI	10009896
	SWG,SF6,3Ø,28KV,2X600GSW,6X200-1ØSW	10009897
	SWG,SF6,3Ø,28KV,2X200GSW,6X200-1ØRFI	10009898
	SWG,SF6,3Ø,28KV,2X200GSW,6X200-1ØSW	10009899
	SWG,SF6,3Ø,28KV,2X600GSW,2X200GSW	30015870
	SWG,SF6,3Ø,28KV,1X600GSW,3X200GSW	30015891
	SWG,SF6,3Ø,28KV,4X200GSW	30016194
	SWG,SF6,3Ø,28KV,4X600GSW	30016964
	PUFF PAC,28KV-150KVLIL-2X600,2X200A-4 W	30019976
5-Way	SWG,SF6,3Ø,15KV,2X600GSW,3X200GSW	10009891
	SWG,SF6,3Ø,15KV,2X600GSW,3X200GRFI	10009892
	SWG,SF6,3Ø,15KV,3X600GSW,2X200GSW	10009893
	SWG,SF6,3Ø,15KV,5X200GSW	10009894
	SWG,SF6,3Ø,28KV,3X600GSW,2X200GSW	10008632
	SWG,SF6,3Ø,28KV,2X600GSW,3X200GSW	30016965
	SWG,SF6,3Ø,28KV,5X200GSW	30018797
	SWG,SF6,3Ø,28KV,2X600GSW,3X200GRFI	30019078

TAPE

Description	MM#
ELECTRICAL INSULATION, TAPE (PVC) BLACK, VINYL, ADHESIVE 20 MM WIDE	30008340
TAPE ELEC,2 INCH,10 YD,20 MIL,BLACK	30008332
TAPE ELEC,2 INCH,10 YD,30 MIL,S/A EPR	30008386
TAPE ELEC,1.0 INCH,10 YD,20 MIL,BLK,S/A	30008334
TAPE ELEC,3/4 INCH, 66 FT, 8.5 MIL,BLACK	30008340
TAPE,DYMO, EMBOSS PRESS SENS. 12MM BLUE	30010060
TAPE,3M PLASTIC,NON TRANS,BLUE 3/4IN W	30010072
TAPE,3M PLASTIC,NON TRANS,RED 3/4IN W	30010073
TAPE,3M PLASTIC,NON TRANS,WHITE 3/4IN W	30010074

TERMINATION

Description	MM#
TERM KIT-28KV-1/0 AWG-COLD SHRINK	30007446
TERM KIT-28KV-2/0 AWG-COLD SHRINK	30007447
TERM KIT-28KV-350KCMIL-COLD SHRINK	30007461
TERM KIT-28KV-500KCMIL-COLD SHRINK	30007487
TERM KIT-28KV-750KCMIL-COLD SHRINK	30007488
TERM KIT-46KV-500KCMIL-COLD SHRINK	30007496
TERM KIT-46KV-750KCMIL-COLD SHRINK	30007459
TERM KIT-46KV-1000KCMIL-COLD SHRINK	30007458
TERMINATION, MOULDED – 46 kV 350 KCM – COLD SHRINK, 4604N-SC350-CT-TAC5/8 (WITH STEM)	30007442

TRANSFORMER, PADMOUNT

Single Phase

Size	Description	MM#
25 kVA	2.4kV-120/240V-1 SWIT	30004860
	4.8kV-120/240V-NO SWIT MICROPAD	30004846
	4.8kV-120/240V-1 SWIT	30004850
	7.2kV-120/240V-NO SWIT MICROPAD	30004847
	7.2kV-120/240V-1 SWIT	30004849
	8kV-120/240V-1 SWIT	30011255
	14.4kV-120/240V-NO SWIT MICROPAD	30004848
	14.4kV-120/240V-1 SWIT	30010604
	16kV-120/240V-2 SWIT	30004807
50 kVA	2.4kV-120/240V-1 SWIT	30014627
	4.8kV-120/240V-1 SWIT	30004851
	7.2kV-120/240V-1 SWIT	30004852
	8kV-120/240V-1 SWIT	30011256
	14.4kV-120/240V-1 SWIT	30004758
	16kV-120/240V-2 SWIT	30004871
75 kVA	2.4kV-120/240V-1 SWIT	30014628
	4.8kV-120/240V-1 SWIT	30004853
	7.2kV-120/240V-1 SWIT	30004854
	8kV-120/240V-1 SWIT	30011257
	14.4kV-120/240V-1 SWIT	30010809
	16kV-120/240V-2 SWIT	30004872
100 kVA	2.4kV-120/240V-1 SWIT	30014795
	4.8kV-120/240V-1 SWIT	30004856
	7.2kV-120/240V-1 SWIT	30004857
	8kV-120/240V-1 SWIT	30011258
	14.4kV-120/240V-1 SWIT	30010975
	16kV-120/240V-2 SWIT	30004873
167 kVA	2.4kV-120/240V-1 SWIT	30014035
	4.8kV-120/240V-1 SWIT	30010751
	7.2kV-120/240V-1 SWIT	30004865
	8kV-120/240V-1 SWIT	30011259
	14.4kV-120/240V-1 SWIT	30014030
	16kV-120/240V-2 SWIT	30013994

TRANSFORMER, PADMOUNT

Three Phase

Size	Description	MM#
150 kVA	4.16/2.4KV-120/208V	30013233
	4.16/2.4KV-347/600V	30014626
	8.3/4.8KV-120/208V	30004812
	8.32/4.8KV-347/600V	30004824
	12.47/7.2KV-120/208V	30004813
	12.47/7.2KV-347/600V	30004825
	13.8/8KV-120/208V	30011261
	13.8/8KV-347/600V	30011262
	24.9/14.4KV-347/600V	30004826
	24.9/14.4KV-120/208V	30004814
	27.6/16KV-120/208V	30004815
	27.6/16KV-347/600V	30004827
300 kVA	4.16/2.4KV-120/208V	30004859
	4.16/2.4KV-347/600V	30014141
	8.3/4.8KV-120/208V	30004816
	8.3/4.8KV-347/600V	30004828
	12.47/7.2KV-120/208V	30004817
	12.47/7.2KV-347/600V	30004829
	13.8/8KV-120/208V	30011263
	13.8/8KV-347/600V	30011265
	24.9/14.4KV-120/208V	30004818
	24.9/14.4KV-347/600V	30004830
	27.6/16KV-120/208V	30004819
	27.6/16KV-347/600V	30004831
500 kVA	4.16/2.4KV-120/208V	30010681
	4.16/2.4KV-347/600V	30010680
	8.3/4.8KV-120/208V	30004820
	8.3/4.8KV-347/600V	30004832
	12.47/7.2KV-120/208V	30004821
	12.47/7.2KV-347/600V	30004833
	13.8/8KV-120/208V	30011266
	13.8/8KV-347/600V	30011267
	24.9/14.4KV-120/208V	30004822
	24.9/14.4KV-347/600V	30004834
	27.6/16KV-120/208V	30004823
	27.6/16KV-347/600V	30004835
750 kVA	27.6/16KV-347/600V	30004875
1000 kVA	8.3/4.8KV-347/600V	30004870
	24.9/14.4KV-347/600V	30004864
	27.6KV-347/600V	30004866

TIE CABLE

Description	MM#
CH CLAMPS-HANGER-28-38MM-CABLE	30006959
CH CLAMPS-HANGER-38-45MM-CABLE	30006960
CH CLAMPS-HANGER-45-53MM-CABLE	30006961
CABLE,TIE,SELF-LOCK,1/16"-5/8" DIA	10000374
CABLE,TIE,SELF-LOCK,1/16"-1-1/4" DIA	30008033
CABLE,TIE,SELF-LOCK,1/16"-1-3/4" DIA	30008071
CABLE,TIE,SELF-LOCK,1/16-3" DIA	30007966
CABLE,TIE,SELF-LOCK,1/16- 4" DIA	30008034
CABLE TIE,SELF-LOCK,3/16"-3-1/2" DIA	30007873
CABLE TIE,SELF LOCK,4.8MM W,36.3MM LG	30007949
CABLE TIE,SELF LOCK,4.8MM W,139.7MM LG	30007955

WASHER

Description	MM#
WASHER-ROUND-14.3MMBOLT-44.5MM-"OD	30001591
WASHER-ROUND-1/4"-9/16"-OD	30001623
WASHER-ROUND-9/16"-1-1/4"-OD (SI BR)	30001681
WASHER-LOCK, SPRING-12.7MM-23MM-OD	30001605
WASHER-LOCK, SPRING-12.7MM-22.3MM-OD	30001611
WASHER-LOCK, SPRING-90.5MM-17.9MM-OD	30001628
WASHER-BELLEVILLE-3/8"-3000LB	30001674