TORONTO HYDRO

REQUIREMENTS FOR

THE DESIGN AND CONSTRUCTION

OF

CUSTOMER-OWNED STRUCTURES

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CERTIFICATE OF APPROVAL

THIS TECHNICAL SPECIFICATION MEETS THE SAFETY REQUIREMENTS OF SECTION 4 OF ONTARIO REGULATION 22/04

PROFESSIONAL ENGINEER	2020/09/30 **DATE**

Table of Contents

1.0 PURPOSE

a) The purpose of this document is to provide guidance to Toronto Hydro Customers and their agents in the preparation of plans and proposals for the construction of new or rebuilding of existing Customer-Owned Structures (i.e. poles, cable chambers, cable pull rooms, duct banks, padmounts, vault and splice vault or splice/tap boxes) where Toronto Hydro cables or equipment shall be present.

b) Nothing contained in this document shall prejudice or supersede any requirements of the current edition of Ontario Electrical Safety Code and the Ontario Building Code.

2.0 DEFINITIONS

a) Customer
A person that has contracted for or intends to contract for connection to a building. This includes developers of residential or commercial subdivision.

b) Easement
The right to use the real property of another for a specific purpose other than for general use and occupation of land.

c) Structures
A general term used to refer to one or more of the Customer-Owned plant where Toronto Hydro cable or equipment will be present.

d) Cable Chamber
A reinforced cast-in place or precast concrete underground structure where duct banks are terminated for the purpose of making cable connections or accommodating a change in cable direction/level.

e) Cable Pull Room
An enclosed structure with a walk-in entrance where ducts are terminated for the purpose of making cable connections or accommodating a change in cable direction/level.

f) Duct Bank
A grouping of ducts either direct buried or encased in concrete.

g) Padmount
A precast reinforced concrete foundation on which padmounted transformers or switchgears are installed.

h) Splice Vault or Splice/Tap Box
A concrete or fiberglass enclosure used for the making of multiple cable connection or terminating ducts.

i) Vault
A reinforced concrete structure used for the purpose of housing transformers, switchgear and other electrical distribution equipment.

j) Pole
A structure used to support overhead lines and equipment.

3.0 REFERENCES

a) The Customer shall reference and conform to the latest version in effect at the date of construction of the following referenced codes, standards, regulations and by-laws:

- Canadian Electrical Code C22.1;
- National Building Code of Canada;
- National Fire Code of Canada;
- National Plumbing Code of Canada;
- Occupational Health and Safety Act – Ontario Regulations 213/91 for Construction Projects;
- Ontario Building Code (OBC);
- Ontario Electrical Safety Code (OESC);
- Canadian Highway Bridge Design Code, CAN/CSA-S6;
- Ontario Fire Code.
- All local municipal and provincial regulations and by-laws.
- City of Toronto Municipal Consent Requirements for the Installation of Plant within City of Toronto Streets.
- The City of Toronto's Sewer By-law Chapter 681.

b) Toronto Hydro Documents:

- Conditions of Service;
- Offer to Connect;
- Requirements for Design and Construction of Customer-Owned High Voltage Substations;
- Technical Specification for Civil Construction Work CV-CON-01;
- Toronto Hydro Rule Book.

c) Toronto Hydro Standards:

The following referenced Toronto Hydro standards will be posted on the Toronto Hydro website:

- 13-2200 Vault Lighting Arrangement
- 15-8510 Temporary Elevated Substations
- 18-5100 Cable Chamber Grounding
- 18-5500 Pad-Mounted Equipment Grounding
- 31-0100 Underground Clearances
- 31-0300 Minimum Depth of Cover For Toronto Hydro Structures
- 31-1120 Concrete Encased and Direct Buried Conduit/Duct Bank
- 31-1150 Depth of Duct Bank
- 31-1230 Supplying Customer Building from Cable Chambers or Vaults
- 31-1350 Duct Bank Support in Place System
- 31-1360 Identification of Hydro Ducts in Building Complexes
- 31-1400 Duct Sealant
- 31-1600 Duct Bank Recess Installation
- 31-2160 Precast Cable Chamber
- 31-2240 Splice Vault 'B' - 3 Piece Precast 1930 x 3050 x 1370 mm Deep
- 31-3160 Splice/Tap Box Type 'C' For Primary Cables Only

- 31-4100 Padmount – Clearance Zone
- 31-4030 Three Phase Precast Padmount 1830 x 1830 x 1220 mm
- 31-4050 Three Phase PMH 9/11 Switchgear 1980 mm x 2160 mm x 1350 mm
- 31-4070 Padmount – Minimum Clearance and Barrier Wall Details
- 31-4080 Padmount - Guard Posts (Bollards)
- 31-6020 Above-Grade Walk-In Transformer Vault
- 31-6030 Below-Grade Transformer Vault
- 31-6035 Above-Grade or Below-Grade Switching Vault
- 31-6040 Stair and Access Well Details for Below-Grade Transformer Vault
- 31-6050 Louver Details For Vent Openings
- 31-6060 Bird Screen Detail
- 31-6070 Cable Pull Room
- 31-6080 4.16 - 13.8 kV Radial and Network System Vaults
- 31-7400 Temporary Support for Primary Cables
- 31-8210 Cable Pulling Loop For Poured and Precast Concrete Walls
- 31-8250 Cable Chamber 180mm Frame and Cover
- 31-8320 Ladderway Grid Frame For Transformer Vault
- 31-8330 Aluminum Ladderway Grid
- 31-8340 Aluminum Ladderway Grid Guard (Gate Stop Flange Detail)
- 31-8350 Vault Exhaust Vent Grid: 1600 x 485 x 127mm
- 31-8360 Vault Exhaust Vent Grid: 1220 x 457 x 127mm
- 31-8390 Transformer Vault Ladder
- 31-8400 Sump Hole Grid & Frame: 650 mm x 650 mm x 38 mm
- 31-8410 Caulking of Removable Slabs
- 31-8450 Ladderway Pipe Barrier
- 31-8470 Sleeve – Lifting For Removable Concrete Slab
- 31-8500 Door For Transformer Vault

4.0 TORONTO HYDRO REQUIREMENTS

4.1 Customer Responsibility

a) Customer is responsible to build new or rebuild existing Customer-Owned Structures according to Toronto Hydro standards and all the other documents referred to in the References Section 3.0 in this document. Detailed construction drawings shall be submitted to Toronto Hydro for review and acceptance. Construction shall not commence until all drawings are accepted by Toronto Hydro.

b) The Customer shall be responsible for providing, inspecting, maintaining, repairing and replacing, in a safe condition satisfactory to Toronto Hydro, all Customer-Owned Structures.

c) Unless there is a written agreement or a drawing that specifies otherwise, all of the following items are considered to be Customer-Owned plant:

1. Structures: vaults, duct banks, cable chambers, padmounts, splice vaults and splice/tap boxes, poles and cable pull rooms;

2. Hardware: doors, vents, louvers, grates, grills, ladders, ladderway enclosures, lids and covers;

3. Grounding: ground rods, grounding loops and all associated hardware dealing with grounding;

4. Drainage: sump pump, oil containment products and all materials associated with drainage;

5. Electrical: light bulb (lamp), circuit breaker panel box, light switch receptacle, GFI outlet, fire alarm, mechanical vents and all materials associated with electrical.

d) It is the Customer's responsibility to obtain approved Toronto Hydro contractors to rebuild all structural deficiencies found in the Customer-Owned Structures.

e) If Toronto Hydro Approved contractors are unavailable, then a qualified contractor or non-qualified contractor can perform civil remedial work provided the following conditions are met:

1. A Toronto Hydro Person in Attendance (PIA) shall be present when work is being conducted inside the structure. One (1) PIA is required for every five (5) crew members.

2. The PIA shall conduct a tailboard meeting to review the dangers in the work space at the start of each work day.

3. Isolations are established when working within the limits of approach.

f) The Customer is responsible for maintaining the Customer's property in a condition that is safe as to not inhibit the operation or threaten the integrity or reliability of equipment or infrastructure owned by the Customer or Toronto Hydro. The Customer's responsibility includes, but is not limited to, clearing vegetation, keeping storm drains clear and drainage systems fully functional, removing debris, maintaining operational and electrical clearances, and maintaining proper grading and surfaces.

g) The Customer shall inspect and maintain the Structures and property at regular intervals. When access to the Structure or property is under the control of Toronto Hydro (e.g. a transformer vault), the Customer shall contact Toronto Hydro at the phone number posted on Toronto Hydro's website to make appropriate arrangements (e.g. access) prior to undertaking any inspections, maintenance, repairs, or replacements.

h) If the Customer does not inspect, maintain, repair, or replace the Structure and all items deemed part of the Structure and property as required, Toronto Hydro may disconnect the supply of electricity to the Customer.

i) Where Toronto Hydro identifies, through an inspection or other activity, deficiencies relating to the Customer-Owned Structures and/or including items deemed part of the Structure, Toronto Hydro may notify the Customer of the deficiencies; provide a reasonable time for the Customer to correct the deficiencies; and if circumstances merit, request the Customer to correct the deficiency in a manner that brings the Structure or property up to current Toronto Hydro standards even if the Structure or property was designed, installed, or constructed to an older Toronto Hydro standard i.e. the existence of health or equipment and any other item dealing with the Structure safety hazards, legal or regulatory requirements, and conditions that may impact the integrity, reliability, or operability of the distribution system or any equipment that supplies the Customer.

j) It is the Customer's responsibility to build all Structures in such a way that there is no leakage of water, hazardous materials or gases into the Customers building. Toronto Hydro shall not be responsible for any damage caused by the leakage of water, hazardous materials or gases entering or exiting the Customer-Owned Structure. If during inspection or other activity it is determined that the Structure is not properly sealed, Toronto Hydro will ask the Customer to remediate this deficiency. Customer can use Toronto Hydro approved material or procure its own material. Materials and all specifications procured by the Customer, shall be reviewed and approved by Toronto Hydro Standards Engineer prior to installation.

k) If Customer requests an equipment upgrade for higher capacity, the Customer shall be responsible for any reinforcement/modification of the structure due to additional weight of equipment.

4.2 Engineering Drawings

a) The Customer shall submit in digital file format (.dgn, .dwg or .pdf) or hard copies of fully dimensioned scaled drawings signed and stamped by a Professional Engineer to confirm the proposal is in compliance with applicable codes and Toronto Hydro requirements.

b) All drawings shall be designed and stamped by the Customer's registered Professional Engineer of Ontario. Customer shall be responsible for ensuring that the Structure is constructed in accordance with the design criteria established by the Customer's Professional Engineer.

c) All drawings shall be reviewed and accepted by Toronto Hydro prior to commencement of construction. Construction must not commence until drawings are accepted by Toronto Hydro. Drawings will be reviewed to ensure that the design aligns with and meets Toronto Hydro operational requirements.

d) If the drawings and information provided do not meet Toronto Hydro requirements or are unclear, revised or additional drawings and information must be submitted for further review and acceptance.

e) All drawings for installations are required to include the following information (if applicable):

- Property lines and easements;
- References to the nearest intersecting streets;
- Location and grade levels of the Structure and the building;
- Location, elevation, section views and any other item dealing with the Structure;
- Layout of the equipment in the Structure clearly indicating aisle clearances and exits;
- Vehicle and personnel access route to the Structure for a truck and/or crane (during and after construction);
- Location of incoming Duct bank;
- Details of Structure grounding arrangements and location of any ground grids used;
- Adjacent utilities such as gas, water, sewers, telecommunications etc.
- Landscaping details;
- Surface and sub-surface features including any obstructions, i.e. overhang, balconies, building emergency access route, stairs or any other feature might be deemed to be an obstruction;
- Drainage details;
- Temporary Shoring Details;
- Structural shop drawings;
- Electrical Drawings showing all relevant information, including, but not limited to: site plan; single line distribution drawings; shop drawings of equipment, transformers, and protection co-ordination study; grounding details; and on-site commissioning of transformer and cable testing results for Customer-Owned HV service entrance equipment.

4.3 Easements

a) Registered easements are required whenever Toronto Hydro's plant is located on private property to service a Customer other than the owner of the property where the plant is to be located.

b) When easement requirements have been identified for a particular project, the Customer shall be responsible for the following:

1. Preparation of a legal survey plan identifying the proposed easement for the overhead and surface/sub surface equipment and also easements where Toronto Hydro deems necessary. It may be necessary to identify the easements in three dimensions. Toronto Hydro requires four (4) copies of the reference plan.

2. Prior to registering the easement, the site survey plan shall be reviewed and accepted by Toronto Hydro.

3. Preparation of a registerable easement in favor of Toronto Hydro comprising of transfer land title deed, schedule 'A' and land transfer tax affidavit. The Easement document shall be prepared by Toronto Hydro's Legal Department.

4. The Customer shall register the easement. The cost of preparing a reference plan, easement, its registration and any other associated cost shall be borne by the Customer as part of the consideration for the provisions of electrical power supply.

4.4 Structures

4.4.1 Location Requirements

a) If possible, Structures shall be located on the premises closest to Toronto Hydro's source of supply.

b) The proposed location of the Structure shall be discussed and accepted by Toronto Hydro prior to the preparation of the formal drawings.

c) During construction, Customer shall not operate cranes in the vicinity of a Structure while Toronto Hydro personnel are working in or around the Structure

d) Structures shall be easily accessible to Toronto Hydro personnel and be located so as to present no undue hazard or danger to the public or Toronto Hydro personnel. Structures shall be located so as to meet all required clearances from obstructions.

e) Structures shall be located away from driveways, loading docks, overhangs/balconies with low vertical clearance less than 5.5 m (18'-0"), patios, building egress/exits, staircase, waste storage areas, locations where dangerous goods or chemicals are stored, and restaurants/processing plants that have a potential of generating liquid waste. Guard posts (bollards) shall be installed if a 1 m (3'-4") clearance to top-access vault roofs cannot be maintained in order to prevent vehicles from driving over or parking on top of access points. Location of guard posts shall not impede access to vault or equipment replacement activities.

f) Structures shall not be installed in the lower part of a sloped area, where water can run off and flood the Structure.

4.4.2 Access Requirements

a) A 6.0 m (20’-0”) wide paved driveway to access the Structure is required. Access route shall be able to accommodate required clearances and weight of large truck or crane and the equipment.

b) Customer shall maintain clean and clear access 24-hours a day during the life of the Structure for maintenance and operational needs. Access routes shall present no undue hazard or danger to Toronto Hydro personnel accessing the Structure.

c) Landscaping or other changes to an access route before or after installation of cables and equipment shall not be made without Toronto Hydro acceptance.

d) No hoarding is allowed to be placed on top of or around a Toronto Hydro Structure during Customer’s site construction without Toronto Hydro acceptance. If hoarding must encroach, it shall not block access to Toronto Hydro personnel. A gate for access by Toronto Hydro personnel shall be provided in the hoarding Structure. The gate shall be equipped with a hasp for a Toronto Hydro padlock. If hoarding exists around a building under construction, a section of hoarding adjacent to the Structure shall be removed by the Customer on request to allow access for cranes and other vehicles required to install Toronto Hydro cables and/or equipment.

e) At existing locations where vehicles obstruct access into the Structure or where vehicles present an undue hazard, guard posts shall be installed around the Structure to prevent vehicle parking and to protect the Structure.

f) Any Customer plant, obstruction, vegetation or other material including but not limited to patios, parking of vehicles, trees, shrubs, and landscaping shall not be built, planted or placed in front or on top of a Structure. This is to enable the safe and proper operation of Toronto Hydro’s distribution system.

4.4.3 Types of Structures

a) Cable Chambers

1. Shall be designed in accordance with Toronto Hydro Standards. Chamber can be constructed using cast-in place as per Toronto Hydro Standard 31-2110 or precast concrete as per Toronto Hydro Standard 31-2160. If precast units are used, dividing sections shall be sealed to prevent water from leaking in. Toronto Hydro Standards Engineer shall review Customer’s chamber specifications, if not meeting Toronto Hydro Standards.

2. Shall have internal dimensions similar to or as specified in Toronto Hydro Standards 31-2110 and 31-2160. Chambers shall have a minimum head-room of 2100 mm (7’-0”) and a maximum head-room of 3000 mm (10’-0”).

3. Customer’s engineer is responsible to provide design and fabrication drawings stamped by a Professional Engineer of Ontario for review and acceptance.

4. Customer's engineer is responsible for designing the roof and walls in accordance with the Canadian Highway Bridge Design Code, CAN/CSA-S6-06, CL-625-ONT live loading.

5. Concrete shall be a minimum 28-day compressive strength of 35 MPa. Concrete shall conform to latest CSA-A23.1. All testing shall conform to latest CSA-A23.2. Reinforcement shall conform to latest CSA standard G30.18, Fy=400 MPa.

6. Chamber roof depth of cover shall be as per Toronto Hydro standard 31-0100. Lids shall be a minimum 450 mm (1'-6") clear of walls. Chamber lids shall be located away from any obstructions or safety hazards.

7. The exterior surface of a roof and neck shall be waterproofed with a self-adhered bitumen membrane.

8. Ducts shall be installed at least 300 mm (1'-0") below ceilings, 300 mm (1'-0") above floors and 225 mm (9") clear of walls. All ducts shall be plugged with duct plugs. All ducts shall be roped.

9. All chambers shall have 3000 mm (10'-0") ground rods installed in all four corners, protruding 150 mm (6") above the floor and 75 mm (3") clear of the walls. Install grounding loop in compliance with Toronto Hydro standard 18-5100.

10. Permanent ladders shall not be installed in cable chambers.

11. All chambers shall have sump holes. Sump holes shall be located in a corner. Chamber floor shall be sloped toward the sump hole. Sump holes shall have removable galvanized grating. Sump hole inside dimensions shall be 300 mm x 300 mm x 300 mm deep (1'-0" x 1'-0" x 1'-0"). Sump hole exact location shall be determined according to site sewer location.

12. All chambers shall be properly drained to the sewer. Drains that cannot connect to a floor drain shall be terminated with a backwater valve at inside wall face. The valve shall be installed, whenever possible, below the lowest incoming ducts. Backwater valves shall be at least 900 mm (3'-0") away from adjacent walls and duct banks, and 300 mm (1'-0") clear of floor.

13. No foreign pipes shall be installed inside cable chambers.

14. Cable pulling loop as per Toronto Hydro Standard 31-8210 or 31-8220 or 31-8230 shall be installed in-line with and opposite of each duct face.

15. Cable racking shall be installed to support cables. Toronto Hydro will install racking and charge back to the Customer.

16. Cables will have to be supported during construction as per Toronto Hydro Standard 31-7400.

b) Cable Pull Rooms

1. Shall be designed in accordance with Toronto Hydro standard 31-6070. Toronto Hydro Standards Engineer shall review and approve Customer's cable pull room specifications, if not meeting Toronto Hydro Standards.

2. Secondary circuit feeding the lighting system inside the cable pull room shall be supplied and installed by the Customer as per the Ontario Electrical Safety Code (OESC). Installation shall be accepted by the Electrical Safety Authority (ESA).

3. For existing locations, the Customer must rebuild the electrical system as needed if defective or corroded.

4. Light switch and GFI outlet shall be installed near the entrance of the Vault with one or two 200 W or LED equivalent light bulbs with lamp holders and lamp covers. Lamp covers shall be supplied and installed by the Customer.

c) Duct Banks

1. Configuration shall be in accordance with Toronto Hydro standard 31-1120.

2. Minimum depth of cover shall be a minimum 800 mm (2'-8") or as per Toronto Hydro standard 31-0300 and City of Toronto Municipal Consent Requirement document. The depth is measured from the top duct bank to the top of final finished grade. If duct banks are built less than minimum depth of cover, added protection shall be added to protect the duct bank as per Toronto Hydro Standard 31-1150.

3. Duct bends shall not be less than 900 mm (3'-0") in radius. Where sweeping bends are necessary, 5° (degree) couplings or sections of long sweep bends shall be used.

4. Duct bank shall be graded and sloped away from Customer's building with a minimum slope of 1-2% sloping towards supply point to prevent water or hazardous materials from entering the building as per 31-1230.

5. Ducts entering building vaults and electrical rooms shall be sealed at the duct face to prevent water or hazardous materials or gases from entering into the Customer's building. Approved Toronto Hydro Contractors can seal the ducts. All spare ducts shall be roped and plugged.

6. All primary cable carrying Duct banks entering Customer's building shall be installed with reinforcement bars tying the duct banks to Customer's building wall to prevent the duct banks from shearing off the wall.

7. Duct bank shall terminate in Customer's building wall with bell end fittings. Duct bank shall be a minimum 150 mm (6") above finished floor or flush with the inside surface of a wall.

8. Duct bank in Customer's building shall be identified as per Toronto Hydro standard 31-1360.

9. For temporary elevated Customer-Owned Structures, duct banks shall be installed in accordance with Toronto Hydro standard 15-8510.

10. Duct banks can be installed in Customer ceiling or suspended from the ceiling meeting OBC and OESC requirements.

d) Padmounts

1. All padmounts shall be precast concrete and shall be installed by Customer in accordance with the Toronto Hydro standards listed in Section 3.0 (c) of this document.

2. Padmount installation requirements:

- Location and access requirements shall be as indicated in sections 4.4.1 and 4.4.2 of this document;
- Be installed on a flat ground level surface on operational side (at door locations) and have sufficient space around the transformer for opening equipment doors;
- Meet all required clearances from adjacent walls, windows, doors, ventilation openings and any other surface Structure. Barriers from windows, doors or ventilation opening and combustible walls/surfaces installed as per Toronto Hydro Standard 31-4070;
- Have minimum overhead clearance of 5.5 m (18'-0") for lifting equipment during removal or installation operations;
- Guard posts shall be installed as per Std. 31-4080 where clearance to curb is not met, or if pad-mount is located in the parking lot or in the path of vehicles;
- Not be fenced off or gated without obtaining Toronto Hydro acceptance.

3. Customer shall procure precast padmounts from Toronto Hydro approved precast manufacturers. A Toronto Hydro representative will provide a list of approved manufacturers to Customer. If Customer decides to procure from a non-approved manufacturer, then Customer shall send P.Eng stamped shop drawings to Toronto Hydro representative for review and approval.

4. Customer is to install grounding in compliance with Toronto Hydro standard 18-5500. If the Customer's grounding design does not comply with this standard, then the Customer shall provide a P. Eng. stamped grounding study that validates compliancy to applicable code requirements, including acceptable ground potential rise (GPR), touch and step potential. The study shall be submitted to Toronto Hydro for review and approval prior to the start of construction.

e) Vaults

1. Location and access requirements shall be as indicated in section 4.4.1-and 4.4.2 of this document.

2. Shall be designed in accordance with Toronto Hydro Standards listed in Section 5.0 of this document.

f) Splice Vault or Splice/Tap Box

1. Location and access requirements shall be as indicated in section 4.4.1 and 4.4.2 of this document.

2. Customer shall install Splice Vault or Splice/Tap Box in accordance with Toronto Hydro standards listed in Section 3.0 (c) of this document.

4.5 Completion Date

a) Structures shall be completed and accepted by Toronto Hydro eight (8) weeks before the requested service date to allow sufficient time for scheduling and for installation and connection of cables and equipment.

b) Equipping of the Structure shall not commence until construction is completed in full and accepted by Toronto Hydro and the Structure can be closed or locked without further entry being required by the Customer or Customer's agents.

4.6 Inspection By Toronto Hydro

a) Toronto Hydro shall be given 48-hours' notice to review and or inspect the concrete Structures (Duct banks, cable chambers, cable pull rooms, splice vaults and vaults). Customer's Engineer must be present during the inspection. Customer's Engineer shall provide a sign-off confirming the work was done according to the design drawings:

- When formwork is completed;
- Before any concrete is poured;
- When construction is completed.

b) Toronto Hydro shall inspect the Customer-Owned Structures to ensure the construction meets Toronto Hydro requirements:

- Dimensions of Structures;
- Access routes (personnel and equipment);
- Drainage (location and workability);
- Primary and secondary duct banks (location and elevation);
- Pulling eyes (installation location);
- Grounding (locations of ground rods, ground loops and bonding of all metallic hardware);
- Proper clearances are met and adherence to Toronto Hydro safety requirements;
- Vault (ventilation, hatchways, grills, removable slabs and caulking);
- A trial lift of the vault's removable slabs shall be arranged by the Customer with Toronto Hydro representative to satisfy Toronto Hydro requirements.

5.0 VAULT DESIGN REQUIREMENTS

5.1 Vault General Requirements

a) Nothing contained shall prejudice or supersede any requirements of the current edition of Ontario Electrical Safety Code and the Ontario Building Code.

b) These General Requirements shall be read in conjunction with Toronto Hydro Standards: 31-6020, 31-6030, 31-6035, 31-6040, 31-6050, 31-6060 and 31-6080.

c) The vault sizes shall comply with Toronto Hydro standards and shall be suitable for oil-filled transformers.

d) Above-Grade, walk-in vault is a preferred type of vault. If not possible, below-grade walk-in or top entry vault can be accepted, provided the vault shall be at the floor immediately below the ground level and accessible from either removable metal grates or concrete slabs.

5.2 Vault Location Requirements

a) Vault shall also be located as indicated in Section 4.4.1.

b) Vaults shall not be installed under or adjacent to public living areas as the effect of sound (low frequency vibrations) produced by the transformers and the cold temperatures produced as a result of the ventilation openings can present unnecessary public complaints. Sound dampening or insulation products can be installed in the vault. P.Eng. stamped drawings including specifications for the products shall be sent to Toronto Hydro for review and acceptance.

c) A minimum of 5.5 m (18’-0”) clear headroom above the vault is required to permit the use of a crane for Toronto Hydro transformers and equipment. Where a below grade vault is required and access with 5.5 m (18’-0”) headroom cannot be provided to the vault, a suitable areaway with necessary crane headroom above, into which equipment could be lowered and moved into the vault, shall be considered.

d) At existing locations where vehicles obstruct entry into the vault, guard posts shall be installed.

e) To ensure that radio communication with the Toronto Hydro Control Centre is adequate, Toronto Hydro may, in its sole discretion, require the Customer to provide provisions for communication equipment installation including the following:

   a. 600 mm x 600 mm interior wall space inside of vault for mounting of Toronto Hydro equipment. Allocated space shall be between 1000 mm and 1700 mm above the floor level and be within 1500 mm of 120 VAC power supply (e.g. receptacle), and within 1 m of access/entry door.

b. 300 mm x 300 mm wall space on outdoor wall of vault structure at least 3 m above ground level for mounting of antenna. Allocated wall space shall have a clear line-of-site to one (or more) Toronto Hydro radio repeater sites.

c. Dedicated civil infrastructure (agreed upon by Toronto Hydro) for running a coaxial cable between equipment installed as per above items a) and b) (e.g. conduit, duct, etc.). The minimum size of conduit/duct shall be 2", with minimum bending radius of 12". Pullbox shall be installed after every two (2) 90 degree bends, with maximum distance of 100 feet between pullboxes.

Toronto Hydro will supply and install the required equipment (e.g. antenna, cable), and assume ownership and maintenance of installed communication equipment.

5.3 Vault Access Requirements

a) Vault access shall be as indicated in Section 4.4.2.

b) The access route shall be designed for crane and truck loadings. The design load for crane shall be to suit the Customer's equipment and location.

c) The Customer shall provide Toronto Hydro with the appropriate access keys or magnetic cards to allow entry from the street to the vault. The access keys or magnetic cards shall be placed in an accessible key box, which can be opened by Toronto Hydro's keys. Also, if a fence is erected around the vault, it shall be provided with Toronto Hydro padlock to allow Toronto Hydro personnel to gain access.

d) Vaults on Customer property shall not be used as a driveway path to getting into the Customer's building.

5.4 Vault Design and Construction Requirements

a) The vault shall be constructed in accordance with the latest editions of the applicable codes, standards and by-laws referenced in Section 3.0.

b) Where vaults are subject to vehicular loading, they shall be designed in accordance with the Canadian Highway Bridge Design Code CAN/CSA-S6-06, CL-625-ONT live loading.

c) As per OBC 3.6.2.27-(3) a vault that is part of a building and houses electrical equipment indoors, shall have roofs or ceilings, walls and floor consisting of reinforced concrete of adequate strength for the conditions and not less than 150 mm (6") thick. As per OBC 3.6.2.7-(4), walls, roofs or ceilings and floors shall be adequately anchored together in a manner designed to resist dislodgement by explosion.

d) Minimum suspended slab loading capacity shall be designed in accordance with Toronto Hydro standards listed in Section 3.0 c) of this document.

e) The grading around a below-grade vault shall be such that water will flow away from the vault roof.

f) No foreign materials or pipes shall be attached to any part of the inside wall, ceiling or floor surfaces of the vault unless accepted by Toronto Hydro. Specifications for proposed products shall be sent to Toronto Hydro for review and acceptance.

g) For walk-in, above grade vaults, pulling eyes shall be installed on the wall or ceiling directly opposite to the duct entry, as specified by Toronto Hydro. Also, a pulling eye shall be installed on the ceiling at door entrance for lifting of transformer into the vault. Pulling eye shall be installed as per Std. 31-8210.

h) For waterproofing purposes, Customer may add waterproofing products to walls, ceiling and floor. Waterproofing products shall be non-conductive and non-flammable. Specifications for proposed products shall be sent to Toronto Hydro for review and acceptance.

i) For below-grade vaults similar to Toronto Hydro underground vaults, doors and ladders shall be built according to Toronto Hydro Standards 31-8390 and 31-8500.

5.5 Vault Grounding Requirements

a) All vaults shall be grounded. Grounding shall be as per Ontario Electrical Safety Code (OESC).

b) Depending on the size of the vault, four or more 19 mm x 3000 mm (¾" x 10'-0") long galvanized steel ground rods shall be supplied and installed by the Customer. Ground rods shall be placed in undisturbed ground. If possible, ground rods shall be taken to the last level of the building into the ground. Ground rods shall be a maximum 3000 mm (10'-0") apart.

c) Alternative grounding locations can be used if ground rods are not placed within 150 mm (6") of inside Vault wall. Grounding drawings shall be submitted to Toronto Hydro for review and acceptance.

d) All metal products including but not limited to doors, ventilation louvers, security bars, ladders, and ladderway enclosures shall be grounded and connected to the grounding loop. An extra flex wire shall be used for this purpose.

e) Toronto Hydro requires 48-hours' notice to inspect grounding before floor is poured.

f) In existing vaults, Customer is responsible to replace ground rods and grounding loop, if existing grounding system is damaged or rusted.

5.6 Vault Electrical Requirements

a) Secondary circuit feeding the lighting system inside the vault shall be supplied and installed by the Customer as per Ontario Electrical Safety Code (OESC). Installation shall be approved by the Electrical Safety Authority (ESA). The secondary circuit shall be 120 V/30 A. The secondary circuit shall be supplied separately from the circuit feeding the vault.

b) For new vaults, lighting system shall be:
- 30 A circuit breaker panel box;

- 200 W incandescent or LED equivalent light bulbs (lamp) with lamp holders and lamp covers;
- 15 A rated light switch;
- 20 A rated GFI outlet.

c) For existing vaults, Customer is responsible to rebuild the electrical system as needed if broken or corroded.

d) Light switch and GFI outlet shall be installed near the entrance of the Vault.

e) Type 1 vault - shall contain 4 light bulbs and Type 2 vault - shall contain 6 light bulbs. Lighting fixtures may be mounted on the ceiling or walls of the vault, provided they are located so that they may be re-lamped without danger to personnel.

f) For new vaults having doors facing the exterior of the building, a light system shall be installed by Customer on the outside wall at 300 mm (1'-0") above center of doors and if possible connected to the building emergency and security lighting systems.

g) 2 x 200 W incandescent or LED equivalent light bulbs with lamp holders and lamp covers along with a suitable switch shall be supplied and installed by the Customer in the air intake chamber shaft as per the Ontario Electrical Safety Code.

5.7 Vault Ventilation Requirements

a) Natural cross-ventilation shall always be used to ventilate the vault. Inlet and outlet vents shall be located in such a way as to provide maximum separation.

b) Mechanically assisted ventilation can be used, if natural cross-ventilation cannot be achieved.

c) As per OBC 3.6.2.7 (9) every vault where self-cooled transformers or other equipment is installed, sufficient ventilation shall be provided to prevent the ambient air temperature inside the vault from exceeding 40° C.

d) As per OBC 3.6.2.7 (10) where the vault ventilation system is fed directly from an outdoor area by natural ventilation without the use of ducts, and where the electrical equipment is the principal source of heat, the combined net area of inlet and outlet openings for ventilation shall not be less than 20 cm^2 (3 in^2)/kVA of maximum projected transformer capacity with a minimum of 930 cm^2 (144 in^2). The net area shall be based on the reduction in airflow due to louvers, bird screens and security bars. The Customer's engineer shall base the net area on the reduction in airflow due to louvers, bird screens and security bars.

e) All ventilation openings in transformer vaults shall be covered with double-louvers, bird screen and security bars. All metal parts shall be galvanized and shall be installed in such a way that they are tamper proof and cannot be removed from the outside by the use of common tools.

f) The Customer shall be responsible to keep the ventilation openings clean from debris and landscaping in order to have adequate ventilation at all times

g) Mechanically assisted ventilation in vaults, if required, shall be approved by a Professional Engineer of Ontario hired by the Customer. A letter signed by the Professional Engineer that the ventilation meets the minimum requirements shall be submitted to Toronto Hydro prior to commencement of the vault construction.

1. Requirements for mechanically assisted ventilation:

- Vault ventilation shall be separate from the main building system;
- Vault temperature is thermostatically controlled;
- Fan is located so that it may be served without danger to the personnel;
- A high temperature alarm is provided in the vault;
- The system is automatically shut off in the event of a fire in the vault;
- A filter is provided in the air inlet if there is a possibility of dirt being drawn in; and
- The Customer shall routinely inspect and maintain the mechanical ventilation.

h) No ventilation is required for vaults only containing switchgears.

i) As per OBC 6.2.3.12 (2), outdoor air intakes and exhaust outlets on the exterior of buildings shall be designed and/or located so that the air entering the building system will not contain a greater concentration of contaminants than the normal exterior air in the locality in which the building is situated.

j) As per OBC 6.2.3.12 (3), Exterior openings for outdoor air intakes and exhaust outlets shall be shielded from the entry of snow and rain and shall be fitted with corrosion-resistant screens of mesh that have openings not larger than 13 mm, except where experience has shown that climate conditions require larger openings to avoid icing over of the screen openings.

5.8 Vault Fire Protection Requirements

a) Fire protection (alarm) systems shall be built in accordance with the latest applicable codes and by-laws, Ontario Building Code and Ontario Fire Code.

b) The Customer shall own and at all times maintain the fire protection (alarm) systems in proper working order.

c) As per OBC 3.6.2.7, the building vault shall be totally enclosed by a fire separation of solid masonry or concrete construction having a fire-resistance rating of not less than 3 hours if the vault is not provided with an automatic fire extinguishing system and not less than 2 hours if the vault is so protected.

d) Customer shall install detectors (alarms) inside the building vault. Customer to verify with the fire marshal's office, the Ontario Fire Code and the Ontario Building Code on the type of detectors required. Detectors shall be located in the ceiling above the door. No other location in the vault shall be accepted. Control wires and/or conduit shall not enter the vault except at the detectors. Detectors shall be connected to the building fire alarm system.

e) As per Ontario Fire Marshal's office, detector alarms are optional or not required for vaults not connected to buildings.

f) As per OBC 3.6.2.7, where a building is required to be equipped with sprinklers, the vault does not need to contain sprinklers provided that vault is designed for no purpose other than the electrical equipment and a smoke detector is provided in the vault that will actuate the building fire alarm system in the event of a fire in the vault. As per OESC 26-008, the electrical equipment in a vault with sprinklers shall be protected where needed by non-combustible hoods or shields arranged to minimize interference with the sprinkler protection.

g) All building vault doors shall be hollow metal fire doors having a fire separation rating of 3 hours or as is indicated in the Ontario Fire Code and the Ontario Building Code. A free sliding pad, tamper proof pad bolt and mortise strike shall be installed. Pad bolt shall be fastened to door and frame with tamper proof bolts. All metal parts including doors, hinges and pad bolts shall be rust proofed. Astragal strips and cadmium plated cane bolts (top and bottom of stationary door) are required on double door installations.

h) All door hinges shall be stainless steel, i.e. mortise type rust proof hinge with non-removable pin and ball bearings or equivalent.

i) An emergency door shall be required in new building vaults as indicated in 31-6020 and 31-6080, location of which shall be accepted by Toronto Hydro. Emergency door shall have panic hardware installed to allow door to open from the inside. There shall be no method of opening an emergency door from the outside.

5.9 Vault Drainage Requirements

a) As per OBC clauses:

- 3.6.2.7 (14) – The floor of the electrical equipment vault shall be liquid tight and surrounded by liquid tight walls and sills of sufficient height to confine within the vault all of the liquid (oil) from the largest item of electrical equipment, but to a height of not less than 100 mm (4").
- 3.6.2.7 (15) – The floor of the electrical equipment vault may be provided with a floor drain connected to a covered sump capable of holding all of the liquid from the largest item of electrical equipment, and the connection shall have a non-combustible trap to prevent the spread of fire from the vault to the sump.

b) The Customer shall provide drainage to the vault, according to the latest version of the Ontario Building Code and the National Plumbing Code of Canada. It is the Customer's responsibility to provide a vault drainage system consisting of a sump pit with a fully functional sump pump and a drain connection to the building drainage system or sewer. The Customer shall be responsible for keeping the whole drainage system clean and operational at all times.

c) The City of Toronto's sewer by-law for discharges to sanitary or combined sewers is located in Chapter 681 of Toronto's Municipal Code. The discharge of oil from a transformer is not

allowed into either the sanitary or storm sewers. Limits for the discharge of oil and grease (mineral and synthetic) are 15mg/L in sanitary and combined sewers, and 0 mg/L in the storm sewers. As the vault equipment (transformers) contain oil, the Customer shall be responsible for installing an oil containment system or barriers in all vaults preventing oil from the equipment (transformers) from draining into the City sewers or building drain system. This requirement will apply to all vaults (new or existing) containing transformers. The Customer shall contact the City of Toronto Environmental Monitoring and Protection Department for confirmation and applicable guidelines and requirements. For legacy vaults, oil containment might not be needed. Customer to verify with the City of Toronto for requirements.

d) The floor shall slope downwards towards the drain with a minimum pitch of 2%.

e) Drains shall be provided under each ventilation and hatchway opening.

f) Precaution shall be taken not to install drains where transformers or other vault equipment is located (under a ladder or in front of a doorway).

g) A backwater valve is required and shall be located inside the transformer vault where possible.

h) Where a sump pump in the vault is used, the pump and its wiring shall be provided and installed by the Customer.