Concurrent Customer Requirements, In-Building Transformer Vaults

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1. Scope

This standard covers requirements for in-building transformer vaults. The topics addressed are listed in the Table of Contents above.

This standard shall be used in conjunction with Seattle City Light (SCL) 0751.00 which states and discusses other requirements, including Accessibility, Location, Construction (Walls, Roof, and Floors), Doorways and Openings, Ventilation, Drainage, Pipes and Ducts, Storage in Vaults, and Sprinkler Systems.

Network-ready vaults shall meet Network vault requirements.

This standard does not apply to in-building vaults that contain switchgear.

2. Application

This standard lists the SCL requirements for in-building vaults. An in-building vault is required if (1) the customer's electrical load exceeds the limits listed in the Requirements for Electric Service Connection (RESC), Table 3.3, and (2) the customer cannot provide exterior space for the installation of SCL transformers and associated equipment of the project premises.

This standard is for use by customers and SCL engineering, customer service, inspection, review, and operations personnel.

3. Conflict

Where conflict exists the following order of precedence shall apply:

1. Project-specific Customer Requirements Package, including the Service Construction Letter and Drawing
2. SCL 0751.00
3. Seattle Building Code, 2006, Section 422 (within the city of Seattle)
4. SCL 0751.60
5. Other SCL construction standards
6. Other industry standards

4. SCL Project-Specific Requirements

When necessary, Seattle City Light Engineering will provide the following project-specific requirements for in-building vaults:

4.1 Minimum vault dimensions, including the height of ceilings

4.2 Direction and location of ceiling channel

4.3 Location and number of vault pulling irons

4.4 Locations for transformer seismic anchors

4.5 Locations and number of ground rods

4.6 Location, size, and number of doors

4.7 Required air flow for vault ventilation (in CFM)

4.8 Location and type of customer's service connection (Service Entrance)

4.9 Routing of high voltage conduit from the SCL distribution system to the customer's in-building vault, including conduit on poles

5. Other Agency Requirements

5.1 Before a customer can be connected to the SCL electrical system, the building electrical system must pass electrical inspection by the Authority Having Jurisdiction. (Refer to the agency issuing the electrical permit.)

5.2 The customer is responsible for the in-building vault to satisfy applicable laws, ordinances, and requirements regarding sound and vibration levels. (Refer to the Washington Administrative Code, King County Ordinances, and city ordinances.)

6. Required Customer Submittals

In addition to the submittals required in the SCL Application for Electric Service packet, the following submittals must also be received and approved by SCL before construction of the in-building vault room:

6.1 The customer's in-building ventilation system shall be designed by a qualified HVAC consultant.

6.2 The customer shall submit drawings showing the design of the in-building vault ventilation system, including intake and exhaust, fans, louvers, dampers, thermostats, air flow direction, etc. Location of all devices and apparatus shall be shown on a plan drawing.

6.3 All topics addressed in the SCL project-specific requirements section shall be shown on customer drawings of the in-building vault room.

7. SCL Required Points of Inspection

Before a customer can be connected to the Seattle City Light electrical system, Seattle City Light personnel must inspect and approve the following items:

- Vault Construction per SCL Construction Requirements Package and SCL Construction Standards
- Grounding:
  - Grounding resistivity shall be 25 ohms or less
  - Exothermic welds, if any, before they become inaccessible
  - Ground cable routing
- Duct Bank Installation: trenching, bedding, conduit installation, encasement, and backfill
- Conduits: cleaning, mandreling, and pull tape installation
- Vault construction, including pulling irons, ceiling channel, seismic embeds, ventilation, and alarm operation
- Other inspections by SCL

Customer shall contact SCL to schedule inspection a minimum of (5) business days prior to inspection.

8. Easements

8.1 Seattle City Light requires an easement if SCL equipment is needed to serve more than one parcel and that equipment is located on private property. In that case, an easement is required over the entire area in which the SCL distribution system will be located.

8.2 If required, a new easement must be secured, or the customer shall provide proof of an existing easement to Seattle City Light before the service will be connected.

8.3 The easement document is prepared separately from the project-specific Customer Requirements Package.

9. General Requirements

Figure 9a. Preferred Layout for a Looped Radial In-Building Transformer Vault

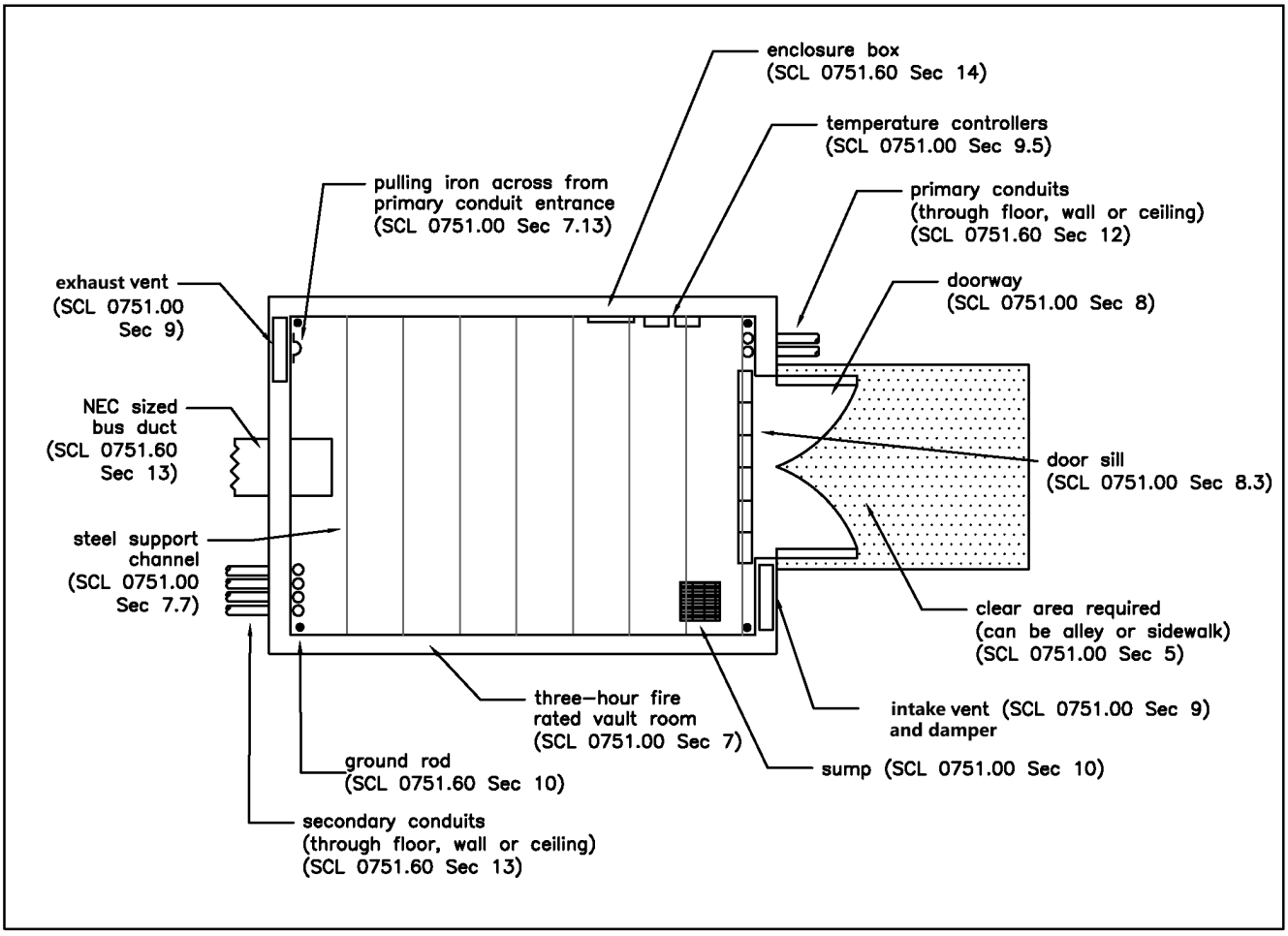
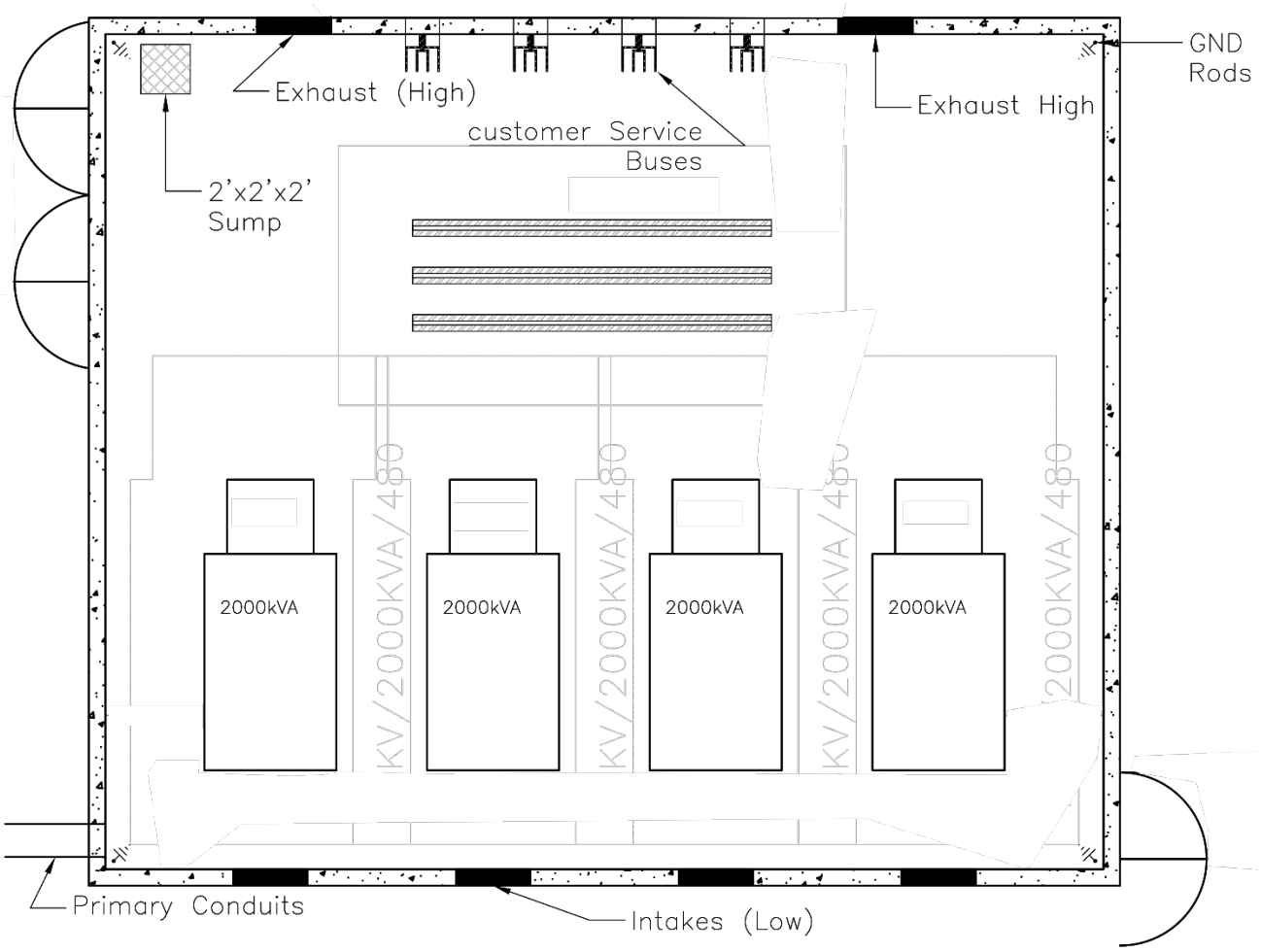


Figure 9b. Preferred Layout for a Network In-Building Transformer Vault



9.1 In-building vaults shall be dry spaces, and no standing water shall accumulate in the vault. The customer shall take adequate measures to prevent water from entering the in-building vault via wall, floor, or ceiling penetrations or via seepage. It is the responsibility of the customer to maintain the vault as a dry space.

9.2 The vault is not to be used for any other purpose except for SCL electrical distribution equipment.

9.3 The vault shall conform to the requirements of Figure 9a or Figure 9b.

10. Vault Grounding

10.1 General Requirements

10.1.1. A driving head shall be used to prevent damage to the ground rod threads.

10.1.2. The space between the rods and the floor shall be caulked and grouted to prevent the entrance of water.

10.1.3. The grounding electrode system shall be constructed to ensure it has a resistance to ground of 25 ohms or less prior to connecting the neutral or service. SCL shall test to confirm compliance. If the electrode system does not result in a resistance to ground of 25 ohms or less, inform SCL engineer. SCL shall advise additional grounding measures required.

10.2 Vaults with Floor Contacting Soil

10.2.1. Grounding for the vault shall consist of four, 5/8 inch by 8-foot copper-clad steel ground rods (Stock No. 564238 or equal) driven into compacted soil near the corners of the vault at least 16 ft apart. See SCL 6762.25.

10.2.2. Each rod shall be placed 6 inches (plus/minus 1/2 inch) from the walls. Confirm locations with inspector prior to rough-in. If this cannot be achieved due to building conflicts such as footings, provide alternative. Alternative ground rod location: Install ground rod within building footprint as close to corner as practical at least 16 feet from other ground rods. Install one 250 kcmil, 600 V insulated copper, soft-drawn, concentric-stranded conductor to vault corner. Conductor shall extend 6 ft into the vault and be exothermically welded to the ground rod.

10.2.3. Rods shall extend 6 inches above the vault floor.

10.3 Vaults with Floor Not Contacting Soil

10.3.1. Grounding for the vault shall consist of four, 5/8 inch by 8 foot copper-clad ground rods, driven into compacted soil within 50 feet of the vault floor and within the building footprint. Exact location will be shown on project-specific drawing. Ground rod connections shall be by exothermic weld. See SCL 0468.90.

10.3.2. Ground rods shall be spaced a minimum of 8 feet apart.

10.3.3. Install one 500 kcmil, 600 V insulated copper, soft drawn, concentric-stranded conductor, to each pair of the ground rods. These two 500 kcmil conductors shall extend 6 feet into the vault from opposite corners. Each conductor shall be attached to each pair of ground rods with an exothermic weld.

10.3.4. The two grounding conductors shall be kept 8 feet apart from each other and be electrically isolated from any other electrical ground cable and building steel.

10.3.5. Outside the vault, the grounding conductors shall be embedded in the concrete building structure with a minimum of 4 inches of cover.

11. Vault Lighting

11.1 For Looped Radial vaults, the customer shall install vault lighting and receptacles per SCL 0674.06.

11.2 For Network vaults, SCL shall install vault lighting and receptacles.

11.3 SCL will connect the power for the lights and receptacles.

11.4 Confirm layout with inspector prior to rough-in.

12. Vault High Voltage (Primary) Entrance

12.1 General Requirements

12.1.1. All conduit bends shall be rigid galvanized steel.

12.1.2. Provide and install conduits from the customer vault to the utility’s facility specified by the SCL engineer.

12.1.3. For Looped Radial vaults, provide and install conduits from the vault to the utility facility specified in the project-specific Customer Requirements Package. Install two 4-inch conduits with a maximum of 270 degrees of bends, unless otherwise specified in the project-specific Customer Requirements Package.

12.1.4. For Network vaults, a maximum of 180 degrees of bend is allowed in the primary conduit run.

12.1.5. After conduit installation, the conduit shall be cleaned and mandreled per SCL 0222.06.

12.2 Conduit in Right-of-Way and Easements

12.2.1. Install and terminate below-grade conduit per SCL 0214.00 and 0222.02.

12.2.2. If applicable, provide and install conduit risers on pole per SCL 0224.34. Exact location shall be included in the project-specific Customer Requirement Package.

12.3 Conduit on Private Property, including within the in-building vault

12.3.1. Install below-grade conduit on private property per SCL 0222.02 and 0224.07.

12.3.2. Starting at one foot outside the building and continuing into the vault, conduit shall be rigid galvanized steel conforming to SCL 7050.05. Conduits shall be isolated from building steel.

12.3.3. Conduit shall be encased within a minimum of 6 in of concrete within building. Red dye shall be added at the equivalent of 4 lb of red oxide per cubic yard. Maximum aggregate size shall not exceed 3/8 in.

12.3.4. If surface of concrete encased conduit bank is visible within building it must be visibly marked with permanent white retro-reflective paint, stating “DANGER–High Voltage Do Not Drill” signs over the concrete encased conduit bank’s entire path within building to vault. Letters shall be 2 inches tall minimum. Install signs once per room and every 10 ft.

12.3.5. High voltage or primary entrances into vaults are cables in conduits.

12.3.6. Conduits entering the vault shall be supplied with closing plugs. See SCL 7345.7

12.3.7. Conduit shall enter the vault perpendicular to the vault wall no more than 18 inches from the adjacent wall. Conduits shall be terminated flush to the wall.

12.3.8. A minimum of 6 inches shall be required between the closest edge of the conduit and the adjacent ceiling or walls. A minimum of 18 inches shall be required between the closest edge of the conduit and the floor.

12.3.9. Conduits entering the vault shall be provided and installed with end bells conforming to SCL 7055.09 and shall be grouted both inside and outside the vault per SCL 0222.06.

12.3.10. Conduits entering the same vault corner but on adjacent walls shall be staggered and shall not enter at the same elevation.

12.3.11. Conduits entering through the floor shall extend 10 in above the floor.

12.3.12. Conduits shall be effectively bonded prior to vault entry. Connect ground clamp (per SCL 6762.7) to a #2 AWG insulated copper bonding jumper and extend into the vault. Conductor shall extend into the vault and be long enough to reach the floor plus 5 feet of coiled conductor.

13. Customer's Service Connection (Service Entrance)

13.1 General Requirements

13.1.1. SCL prefers that the customer provide NEC-sized bus duct into the in-building vault. NEC-sized cables in conduit are also acceptable. SCL allows only one type of service (bus duct or cables) per vault, except in the case of fire pump services, emergency services, or legally required standby services.

13.1.2. All service entrance penetrations shall be sealed, including bus duct, conduits, and cables.

13.1.3. Rotation of service bus bars or cables shall be clearly identified by the customer and in case of multiple services, it shall be consistent across all services.

13.1.4. Each service shall be labeled. Include the service ampacity, voltage, and phases. See 7651.25.

13.2 Service Entrance using Bus Duct

13.2.1. Provide and install NEC-sized secondary bus duct into the vault per SCL 0474.08. Bus duct penetrations shall not exceed bus duct dimensions by more than 2 inches (width or height).

13.2.2. Brace and support the bus duct.

13.2.3. Label each bus bar for phasing.

13.2.4. The bus duct is centered on the wall.

13.3 Service Entrance using Cables in Conduit

13.3.1. Provide and install NEC-sized service conduits and cable from switchgear into vault per SCL 0473.50. For Network vaults, Customer shall furnish cable limiters. Conduit shall be rigid galvanized steel throughout the depth of the wall, floor, or ceiling. No more than 12 cables per phase or neutral are allowed. Grounding and bonding of conduits shall be external to the vault and is subject to inspection by the Authority Having Jurisdiction.

13.3.2. Conduits entering the vault shall be supplied with closing plugs.

13.3.3. Conduit shall enter the vault perpendicular to the vault wall, floor, or ceiling, no more than 18 inches from a corner.

13.3.4. Conduits entering the vault shall be terminated with PVC end bells and shall be grouted both inside and outside the vault per SCL 0222.06.

13.3.5. Conduits entering the same vault corner but on adjacent walls shall be staggered and not enter on the same elevation.

13.3.6. If conduit is entering through the floor, it shall extend 8–10 inches above the floor. Pour 4" concrete housekeeping pad flush to top of end bells. Chamfer corners and finish smooth. See SCL 7651.25.

13.3.7. Label each cable to identify phasing.

13.3.8. If multiple services, label each set of cables with the service being fed.

13.3.9. Fire seal the cable installed in conduit for a three-hour rating using rockwool and rated grout or fire-barrier caulk in order to protect migration of fire, smoke, and gas.

14. Vault Document Enclosure

14.1 Install a permanent, weatherproof clear document enclosure box on the vault wall near the light switch or the thermostats.

14.2 The document enclosure shall be adequate for permanently storing 8-1/2 by 11-inch documents.

15. Requirements of Other Utilities

15.1 SCL construction standards and guidelines do not cover the installation of telecommunications or any other utility's equipment serving a project.

15.2 Seattle City Light does not coordinate with other utilities for installations in the public right-of-way.

16. References

SCL Construction Standard 0222.02, "Requirements for Primary Conduits and Duct Banks"

SCL Construction Standard 0222.06, "Duct Bank Terminations"

SCL Construction Standard 0224.07; "Requirements for Secondary Conduit Installation"

SCL Construction Standard 0224.34; "Steel Conduit Risers"

SCL Construction Standard 0468.90; "Exothermic Connection System"

SCL Construction Standard 0473.50; "Looped Radial and Network Service Entrance Cables in Conduit"

SCL Construction Standard 0474.08, "Looped Radial and Network Dry Vault Service Entrance Bus Duct"

SCL Construction Standard 0674.06; "In-Building Vault Lighting and Receptacle Requirements, Looped Radial System"

SCL Construction Standard 0751.00; "Customer Requirements, In-Building Transformer Vaults, Network and Looped Radial Systems"

SCL Construction Standard 0751.77; "In-Building Vault Equipment Clearances"

SCL Construction Guideline U2-11.40/NDK-40; "Mandreling and Cleaning of Ducts and Conduits"

SCL Material Standard 6762.25; "Ground Rods, Copper-Covered, Sectional"

SCL Material Standard 7050.05; "Zinc-Coated Steel Conduit and Fittings"

SCL Material Standard 7055.09; "DB120, PVC Conduit Fittings"

SCL Material Standard 7345.7; "Fittings For Underground Use, PVC"

SCL Material Standard 7651.25; "Customer Requirements for Vault Signage"

17. Sources

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Edwards, Tommy; SCL Electrical Reviewer and subject matter expert for 0751.60

Hall, Alan; SCL Engineer and subject matter expert for 0751.60

NFPA-70, National Electric Code (NEC); 2008 Edition, National Fire Protection Association, Quincy, MA, 2010

Requirements for Electric Service Connection (RESC); Seattle City Light

SCL Construction Standard U2-10/NDK-50 (canceled); “Electrical Conduit and Facilities in Public Rights-of-Way”

SCL Construction Guideline U2-8 (canceled); “In-Building Transformer Vaults (Non-Network Area)”

SCL Construction Guideline U7-10/NDK-70 (canceled); “Conduit Risers on Poles”

SCL Construction Standard U7-10.2/NDK-90 (canceled); “Primary Conduit Riser Pole Base Detail”

SCL Construction Guideline U10-2 (canceled); “Transformer Service Vaults and Padmounts, Customer’s Responsibility, Outside Network Area”

SCL Construction Guideline U10-2.1 (canceled); “Transformer Service Vault, In-Building, Dry, Outside Network Area”

SCL Construction Guideline U10-2.2 (canceled); “Transformer Service Vault In-Building, With Outdoor, Below Ground Access, Outside Network Area”

SCL Construction Guideline U2-8 (canceled); "In-Building Transformer Vaults (Non-Network Area)"

SCL 2007-2008 In-Building Vault Subcommittee: Shayan Arya, Ed Chu, Toni Gamble, Laurie Hammack, Bob Hansen, Gerard Legall, Eivind Perander, Uzma Siddiqi, Quang Ta, and Roger Tapp

Siddiqi, Uzma; SCL Standards Engineer, subject matter expert, and originator of 0751.60