# Requirements for Customer-Owned Primary Services Supplied at 4 kV to 35 kV

# Primary Guide

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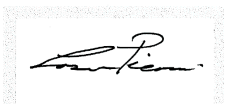
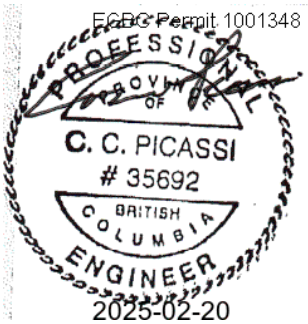
| Recommended:<br>C. Picassi, P. Eng |  | Professional of Record<br>  |
| Reviewed:<br>H. Giesbrecht, P. Eng |  | |
| Approved:<br>H. Giesbrecht, P. Eng |  | |

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**Distribution Design and Customer Connections**

Wesley Rink, Adam Miller, Josh Fidel, Jason Huynh, Jason Jeffrey, Justin Whissel, Susan Tarbit, Devin O'Gorman, Bruce Sarvis, Carina Lawrence, Stefano D'Errico, Rod Nickmaram

**Distribution Engineering**

Hristin Stoichev, Paul Therrien, Ben Casement, Bill Kiedaisch, Sherif Zelbassionuny, Josh Patton, Tyler Ferguson, Stefano Chirardello, Jen Coote, Marvin Galvez, Mary Congdon

**Distribution Standards**

Mark Kelvin, Grant Ringham, Mark Stevens, Scott Mercer, Hudson Giesbrecht

**Revenue Metering**

Des Boshnakov

**Technical Services BC (TSBC)**

Michael Pilato, Jeremy Overton

# Table of Contents

# 1 Interpretation

This document contains the requirements for the design, construction, installation, access, and connection of customer-owned primary services supplied by the BC Hydro distribution system at 4 kV to 35 kV. Primary service connections are subject to BC Hydro's terms and conditions, which form part of the distribution tariff, according to Distribution Instruction A10-2 *Service Agreements*.

Note 1: See the BC Hydro document *Technical Interconnection Requirements for Transmission Voltage Customers for Service at 60,000 to 287,000 Volts* for electrical energy supply at 60 kV and above.

This Primary Guide is intended neither as a design specification nor as an instruction manual for customer-owned primary services. This document shall not be used by the customer, nor their contractors or consultants, for such purposes.Persons seeking to use the information included in the guide do so at no risk to BC Hydro and they shall rely solely upon themselves to ensure their use of all or part of this document is appropriate in the particular circumstances.

BC Hydro customers, their servants, and agents shall recognise they are solely responsible for their own design, construction, installation, and operation at all times. Neither BC Hydro nor any of its employees or agents shall either be or become the agent of the customer in any manner howsoever arising.

BC Hydro's review of the specifications and detailed plans shall be construed as neither conforming to or endorsing the design of, nor as warranting the safety, durability, or reliability of, the customer-owned primary service. Due to such reviews or lack thereof, BC Hydro shall neither be responsible for the strength, adequacy of design, nor capacity of equipment built pursuant to such specifications, nor shall BC Hydro or any of its employees or agents be responsible for any injury to the public or workers resulting from the failure of customer-owned primary services.

An assertion by BC Hydro or any of its employees or agents that the customer-owned primary service equipment design meets certain limited requirements of BC Hydro does not mean, expressly or by implication, that all or any of the requirements of the law or other good engineering practices have been met by the customer-owned primary service, and such judgement shall not be construed by the customer or others as an endorsement of the design, nor as a warranty, by BC Hydro or any of its employees or agents. If the customer opts to install BC Hydro standard products certified for utility use, the customer's engineers and contractors assume full responsibility and liability for the application, installation, approval, and use of such products and structures.

It is not the duty or function of BC Hydro's to interpret or enforce the Canadian Electrical Code as applicable to the customer-owned electrical installation.

Note 2: Revision 4 (2025) of the Primary Guide supersedes revision 3.1 and all previous revisions. A reference to any document external to the Primary Guide always implies the most current edition/revision of said document.

# 2 Definitions

| Term | Definition |
|---|---|
| Acceptable | Confirms that the customer-owned primary service design and specifications comply with the requirements of the BC Hydro Primary Guide. |
| Approved equipment | Electrical equipment certified by a certification agency accredited by the Standards Council of Canada in accordance with Canadian Standards Association (CSA) standards requirements, or other accredited documents where such CSA standards do not exist or are not applicable. |
| Authenticate | The act of a professional registrant manually authenticating or digitally authenticating a document. |
| Authorization for connection | BC Hydro form issued by Distribution Design authorizing a customer service connection to the BC Hydro distribution system. |
| BC Hydro representative | BC Hydro agent responsible for processing the customer application for primary service connection and adherence to BC Hydro requirements and distribution standards. |
| BCEC | The British Columbia Electrical Code is CSA C22.1 *Canadian Electrical Code Part I*, adopted and amended in section 20 of the *Electrical Safety Regulation*. |
| Basic impulse level | As defined by CSA standards. |
| CLPU | Cold load pickup is a steady-state overcurrent condition that occurs when a system is energized following an extended outage. The increase in current is due to the loss of diversity in loads. |
| Conduit | Raceway of circular cross-section through which power cables or conductors are drawn. |
| Certified or approved | Mark of approval or certificate of compliance for regulated products as required by TSBC Information Bulletin B-E3 071019 3 *Approved Certification Marks for Electrical Products*. |
| Consumer's service | Portion of the consumer's installation from the service box or its equivalent, up to and including the point at which BC Hydro as supply authority makes its connection. |
| Current permit | Written permission from the inspection department to a supply authority stating that electric energy may be supplied to a particular installation. |
| Customer | Any individual, person, partnership, company, or other entity receiving services from BC Hydro. |
| Dead zone in primary switchgear | Portion of service main on the source side of a breaker where customer protection current transformers are located on the load side of the service main breaker. |
| Distribution operating order | Formerly the local operating order, a special operating or maintenance procedure issued by BC Hydro to attend to, operate, and maintain certain equipment or apparatus connected to the BC Hydro distribution system. |
| Distribution standards | Standards for construction of a BC Hydro electrical distribution plant within the BC Hydro service area. |
| EGBC | Engineers and Geoscientists BC, the regulatory authority for professional engineers and geoscientists in B.C. |

| Term | Definition |
|---|---|
| Electric service agreement | Formal legally-binding contract between BC Hydro and the customer that sets forth the terms of electrical energy supply. |
| Electrical operating permit | Permit to operate, maintain, and carry out minor alterations to the customer primary service per the B.C. *Safety Standards Act* and TSBC Directive B-E3 0708017 *Electrical Operating Permit Requirements* |
| Instrument transformer compartment | Switchgear cell or section of the primary service assembly containing revenue metering transformers, consisting of an enclosed metal box or cabinet constructed to be effectively locked or sealed. |
| Isolating switch | Switch intended for isolating a circuit or equipment from its supply source which shall not be used for interrupting the flow of current. |
| Licensed electrical contractor | Person holding a licence as a contractor for the class of electrical equipment or electrical installation defined by TSBC. |
| Meter cabinet | Lockable wall-mounted metal box containing a Measurement Canada-certified BC Hydro revenue meter connected to the revenue metering instrument transformer compartment. |
| Point of connection | Physical location in the primary service equipment where BC Hydro, as supply authority, terminates service cables or conductors to deliver electrical energy. |
| Primary Guide | BC Hydro document containing the requirements for design, construction, installation, access, and connection of customer-owned equipment for primary services supplied by the BC Hydro distribution system at 4 kV to 35 kV. |
| Primary service | The customer's service equipment connected to BC Hydro, as the supply authority, at primary distribution of 4 kV to 35 kV. |
| Primary service declaration | BC Hydro form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment* available at all design offices. |
| Primary service dual supply | Two feeder supply required by large loads (exceeding 6.5 MVA in a 7.2/12.5 kV area or exceeding 13.0 MVA in a 14.4/25 kV area) or by customers needing extra service reliability. |
| Primary service kiosk | Customer-owned outdoor structure containing an incoming service cable compartment, service switch, or breaker, and the outgoing cable compartment for connection of customer-owned cables. The kiosk may include a revenue metering cubicle, a service transformer, and secondary switchgear as a complete unitized substation. |
| Primary service switchboard | Switchgear assembly or portion thereof consisting of one or more switchgear compartments or cells, containing a primary service cable termination compartment, a service switch or breaker and associated relaying, and, where applicable, a primary revenue metering cubicle. |
| Primary service vault | See service vault. |
| Primary voltage | Voltage greater than 750 V and up to 34.5 kV, measured phase-to-phase. |
| Professional of record (POR) | Professional registrant who is professionally responsible for activities, work, or documents related to the regulated practice. |
| Protective barrier | Permanent or removable insulation board or fitting, mounted separately from the exposed electrical components, to prevent contact with energized components. |
| Pull box | Approved metal or concrete box to facilitate installation of service cables or conductors. |

| Term | Definition |
|---|---|
| Regional distribution engineer | Professional engineer in BC Hydro's employ responsible for a designated portion or a geographic area of the BC Hydro distribution system. |
| Registered class A electrician | Licensed electrical contractor with unlimited voltage restriction and trade qualifications per the B.C. *Safety Standards Act*. |
| Regulatory authority | Ministry or local government that provides for inspection services and has the authority to require inspection of electrical work in B.C. |
| Rigid metal conduit | Rigid conduit of metal pipe made to the same dimensions as standard pipe and suitable for threading with standard pipe threads. |
| Secondary voltage | Voltage up to and including 750 V, measured phase-to-phase. |
| Service box | Approved assembly consisting of an enclosure that can be locked or sealed, containing either a circuit breaker or fuses and a switch, where the switch or circuit breaker can be moved to the open position by manual means when the box is closed. |
| Service connection | Part of BC Hydro's distribution facilities extending from the first attachment point on BC Hydro's distribution system to the point of connection. |
| Service vault | Room or space in a building to accommodate service equipment, constructed in accordance with the National Building Code of Canada and applicable local legislation and bylaws. |
| Shunt trip | Approved assembly consisting of a pushbutton enclosure that can be locked, containing a pushbutton with ¼-turn release, hard-wired to the trip coil of a circuit breaker, interrupter, or loadbreak switch. |
| Supply service | Any one set of conductors run by a supply authority from its mains to a consumer's service. |
| Supply service cable compartment | Switchgear cell or section of the primary service assembly containing primary service cables or conductors, and consisting of an enclosed metal box or cabinet constructed to be bolted down with three penta bolts, and locked by a BC Hydro padlock. |
| Single radial supply | Comprising the incoming cable termination and a gang-operated disconnect or loadbreak switch. |
| Statutory right-of-way | Registered right-of-way on private property or inside a customer-owned building granted by the owner to BC Hydro for its function as an electric utility. |
| Supply authority | Any individual, person, partnership, company, or other entity in B.C. supplying electric energy. |
| TSBC (Technical Safety BC) | Organization responsible for administering and enforcing the BCEC in B.C. |
| Visible disconnection point | Physical location in primary service equipment where supply may be interrupted and that allows direct and safe visual confirmation of separated contact by BC Hydro personnel without the use of climbing structures. |

# 3 System Requirements

## 3.1 Design and Compliance

The safety and reliability of each primary service is important to BC Hydro. New primary service equipment shall be rated and certified for operation at 14.4/25 kV. Customer connections in 14.4/25 kV service areas need not be dual-voltage rated. Initial operation at 7.2/12.5 kV may be required in some areas. BC Hydro distribution supply is 19.9/34.5 kV in some rural areas.

Note 3: BC Hydro shall not supply any customer primary service designed and constructed to operate as a three-phase two-wire service, regardless of geographic location.

Customer-owned primary service equipment and installations shall be technically compatible with the BC Hydro distribution system to ensure public safety and facilitate safe and reliable delivery of electrical energy. BC Hydro distribution systems are built in accordance with BC Hydro distribution standards, which are developed, maintained, and approved by professional engineers. Designs for customer-owned primary services shall be authenticated by a professional engineer. Deviations from BC Hydro distribution standards that are directly applicable to the customer's installation shall be accepted and approved by BC Hydro.

Customer-owned primary services are within TSBC jurisdiction and all equipment shall bear evidence of either a mark or a label of a certification agency accredited by the Standards Council of Canada, or an approval label issued by TSBC or other accredited organization under section 10 of the *Safety Standards Act* such as the SPE1000 model code field approval. Installations shall be completed in compliance with the BCEC by a class A electrical contractor licensed by TSBC and in good standing. Customers exempt from the BCEC shall provide BC Hydro with a confirmation letter from the AHJ that a subject primary service is suitable for connection to the BC Hydro distribution system. This does not exempt such customers from fully complying with BC Hydro requirements as the supply authority.

Customer primary service installations that do not meet BC Hydro requirements may be connected and maintained under a special provision through a distribution operating order. This may carry extra charges to the customer for service calls, regular inspections, and required maintenance by BC Hydro personnel.

Note 4: Customer-owned primary service equipment, operation, and installation are the jurisdiction of TSBC and subject to the BCEC. BC Hydro will not issue an authorization for connection for customer-owned primary service until the customer provides a certificate of inspection from a class A LiFSR demonstrating that service connection has been passed or the inspection has been waved.

## 3.2 Utility Access

Access to the primary service location on private property and to supply service conductors and revenue metering, including operation and safe isolation of the main service switch, shall be compliant with BC Hydro work procedures, WorkSafeBC rules, and the BC Hydro *Electric Tariff*.

See 8.3.1 Vault Location and Access for location and access requirements for buildings with indoor primary service vaults.

Buildings supplied by an open loop configuration with the BC Hydro switchgear room located inside require BC Hydro parkade access with a keyed switch access panel connected to the parkade overhead door electric operator, and a parking space adjacent to the switchgear room reserved and available for BC Hydro use at all times. See 7.4 Customer Scope of Supply for Indoor Primary Service Vaults for more information.

BC Hydro crews require unobstructed roadway access to primary overhead services for line trucks to the customer's first pole and revenue metering pole.

## 3.3 Supply Configuration

Primary service supply configuration depends on geographic location, service rating (kVA), and service connection type (overhead or underground). The six supply configurations are:

a. Single radial supply: The most common configuration for overhead and underground supply throughout the province (see drawings PG A1-01 *One Line Diagram Single Radial Supply Typical for U/G Supply Service* and PG A1-02 *One Line Diagram Single Radial Supply Typical for O/H Supply Service* in Appendix 1 List of Primary Guide Standards). The customer service connection for overhead supply includes a pole-mounted loadbreak switch and fused cutouts. The customer service for underground supply may comprise an incoming cable cubicle and loadbreak switch with fuses, or an isolation switch in conjunction with a circuit breaker or interrupter. Some indoor installations use draw-out breakers.

b. Primary loop supply: An obsolete configuration used in certain areas (e.g. Surrey, Victoria) as defined in the *Electric Tariff*.

c. Primary open loop supply: Customers in areas designated by BC Hydro may receive a single radial supply from BC Hydro-owned switchgear located on the customer's premises in an inside room or outside space. Switchgear space requirements are outlined in the underground civil standards. See BC Hydro standard ES54 E3-04 *Below Ground Switchgear BC Hydro Vault on Private Property,* ES54 E4-04 *Above Ground Switchear BC Hydro Vault on Private Property,* or ES54 E6-01 *BC Hydro Switchgear Vault in Customer-Owned Building Single Radial Supply* for more information on switchroom requirements inside customer buildings. BC Hydro staff can refer to report BCH-DSR-2015-6043 *Distribution Design Policy – Underground Switchgear* for more information on switchgear configuration.

d. Dual radial supply: An obsolete configuration comprising one running and one standby feeder. Effective April 1, 2009, a customer requesting service in a previously designated dual radial area is offered single radial supply, or may be requested to provide space on their property for BC Hydro switchgear to facilitate primary open loop supply.

e. Dual supply: May apply to large connected loads as defined by BC Hydro (typically exceeding 6.5 MVA in a 7.2/12.5 kV area or exceeding 13 MVA in a 14.4/25 kV area). Customers may be served by two feeders (see drawing PG A2-01 *One Line Diagram Dual Supply* in Appendix 1 List of Primary Guide Standards). Customers connecting such large loads to BC Hydro's system shall consult with BC Hydro to establish connection requirements prior to commencing construction.

f. Dedicated backup supply: May be available upon customer special request at BC Hydro's discretion.

BC Hydro continues to upgrade the distribution system and to use remotely-operated automated switchgear for improved service reliability. Dual radial and double dual radial service connections are no longer available for new construction. All BC Hydro primary customers will receive some form of radial supply configuration with system redundancy. Redundancy of the supply system could be provided by BC Hydro-owned switchgear in some geographic locations, which may be located on the customer's private property or inside a customer-owned building, and may require a BC Hydro right-of-way.

Note 5: The customer shall contact the area's BC Hydro representative regarding supply configuration for a proposed primary service supply. Contact a BC Hydro representative for further information on special requirements and available feeder capacity.

## 3.4 Point of Connection

The point of connection for overhead and underground primary service supply shall follow the applicable rules of BCEC section 36 *High-voltage installations* and TSBC Information Bulletin IB-EL 2016-02 *High voltage installations*.

The BC Hydro point of connection for overhead service shall be the first customer-owned pole located on private property, and for underground service the supply service cable compartment. The undergound point of connection shall be either apparatus bushings (for dead-front services) or National Electrical Manufacturers Association (NEMA) patterned buses (for live-front services).

The BC Hydro point of connection for underground indoor service shall be the utility service cable compartment above a cable pull pit located on a ground floor or parking level P1. A P2 location is acceptable if ground floor and P1 are unavailable due to local AHJ bylaws. A point of connection above ground level is not acceptable to BC Hydro. See 3.2 Utility Access for additional requirements. The cable pull pit in high flood plain areas may be replaced by a pull box located outside the building near the primary service, subject to acceptance by a BC Hydro representative.

Pull pits are not acceptable for underground outdoor kiosk service. A pull box must be located within a short distance of the kiosk per ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation* and ES54 S3-02 *Primary Services Live-Front Outdoor Kiosk Private Property Installation*.

If a customer installs non-compliant primary service equipment or has extenuating circumstances which result in the need to restrict BC Hydro access to the primary service location, BC Hydro requires a demarcation structure as the point of connection. This demarcation structure shall be pad-mounted and pre-approved by BC Hydro as the supply authority, and by the AHJ. The demarcation structure shall be supplied and installed by the customer and located inside the customer property line. The demarcation structure shall ensure separation between the customer and BC Hydro equipment in the form of a primary service kiosk compliant with this Primary Guide, or a pad-mounted enclosure design acceptable to BC Hydro. A BC Hydro standard 832 box is not acceptable. See Appendix 2 Reference Documents for further information on the requirements of a demarcation structure.

Note 6: BC Hydro shall not connect customer service to a building or structure that violates minimum clearance requirements to BC Hydro overhead lines as stipulated by CSA C22.3 No. 1 *Overhead systems* and BC Hydro ES43 overhead electrical standards.

Single-family residential building electrical service shall be supplied at secondary voltage as determined by a BC Hydro representative in accordance with 6.1.2 Secondary Supply Voltage.

## 3.5 Revenue Metering

BC Hydro accepts primary or secondary revenue metering for all primary services but prefers secondary metering as the lower cost option. BC Hydro specifies clearances, location, and enclosure dimensions as the supply authority in accordance with BCEC section 6 *Services and service equipment*. Customers using a secondary metering design shall include the service entrance equipment up to and including revenue metering.The final metering configuration shall be determined in consultation with a BC Hydro representative.

BC Hydro requirements for primary overhead metering include a separate dedicated customer-owned new class 2 wood pole (typically the second pole on a private line) for the installation of a revenue metering assembly and associated surge arresters (see BC Hydro standard ES43 J7-01 *Primary Revenue Metering*). Customer-owned equipment shall not be installed on a revenue metering pole, except for surge arresters per drawing PG A1-02 *One Line Diagram Single Radial Supply Typical for O/H Supply Service* (see Appendix 1 List of Primary Guide Standards).

Note 7: BC Hydro primary revenue metering for overhead and underground service connections shall be located after the customer service main overcurrent protection devices.

BC Hydro requirements for primary underground services includes a separate metering cubicle with access restricted to BC Hydro personnel only. Customer-owned equipment shall not be installed inside a revenue metering cubicle. Potential transformers and current transformers in the metering cubicle shall meet the requirements specified in the BC Hydro document *Requirements for Primary Service Voltage Revenue Metering (4 kV to 35 kV).*

It is acceptable to provide openings of a sufficient size through the sides of the instrument transformer compartment to maintain the required phase bus clearances , i.e. there is no requirement to completely barrier these openings with insulating material up to or contacting the phase buses.

See the BC Hydro document *Requirements for Primary Service Voltage Revenue Metering (4 kV to 35 kV)* for more on primary metering.

The point-of-metering (POM) shall be on the service transformer secondary side where practicable. The POM may be on the primary side under special circumstances (subject to BC Hydro acceptance), including:

a. Multiple service transformers;

b. A single service transformer with multiple secondary windings;

c. A single service transformer with non-standard secondary voltage; and

d. A customer-owned primary voltage overhead power line.

Revenue metering with the POM on the secondary side shall be in accordance with the BC Hydro document *Requirements for Secondary Voltage Revenue Metering (750 V and less)*.

Copies of applicable BC Hydro distribution standards documents, including revenue metering documents, are available on the BC Hydro website.

Warning: BC Hydro issues refurbished primary revenue metering transformers to contractors for installation inside customer-owned primary service switchgear. Refurbished metering transformers may have a reduced dielectric strength rating compared to the customer-owned switchgear. When the customer carries out the necessary type testing per CSA standards, BC Hydro potential transformers shall be disconnected by removing primary fuses, and each current transformer shall be jumpered across by a solid copper bus between transformer terminals.

## 3.6 Power Quality

### 3.6.1 Voltage Planning Levels

Frequency, steady-state range, and unbalance are important network voltage characteristics for the design of customer facilities. BC Hydro feeder planning levels for these voltage characteristics are summarized in this section. BC Hydro ES55 design standards section Q2 *Power Quality Planning Limits for Low and Medium Voltage Networks* details these and other voltage characteristics and is available upon request.

#### 3.6.1.1 Voltage Frequency (ES55 Q2-02)

The BC Hydro primary voltage supply frequency is 60 Hz, with an acceptable performance deviation band of ±1.0% (59.4 Hz to 60.6 Hz), per CAN/CSA-IEC C61000-2-2 *Electromagnetic compatibility (EMC) - Part 2-2: Environment - Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*.

#### 3.6.1.2 Steady-State Voltage (ES55 Q2-03)

BC Hydro primary voltage supply shall comply with CAN-C235-83 *Preferred Voltage Levels for AC Systems, 0 to 50 000 V*, which stipulates that voltage deviation shall not exceed ±6.0% from the nominal supply voltage. Assessment of steady-state voltage performance requires that measured 200 ms root-mean-squared voltages are aggregated over 10-minute intervals, per CAN/CSA-IEC 61000-4-30 *Electromagnetic compatibility (EMC) — Part 4-30: Testing and measurement techniques — Power quality measurement methods*. The first percentile and 99$^{th}$ percentile voltage levels measured over a one-week period shall fall within the prescribed CSA range. The analysis excludes measured quantities during outages and uncontrollable network faults.

#### 3.6.1.3 Voltage Unbalance (ES55 Q2-07)

Supply voltage unbalance is less than 2.0% at standard locations and less than 3.0% at rural locations. Customers on non-integrated networks and customers with points of interconnection located greater than 20 km from a BC Hydro substation are considered rural. Assessment of voltage unbalance performance requires measurement of average negative-sequence voltage unbalance over 10-minute intervals, per CAN/CSA-IEC 61000-4-30. The 95$^{th}$ percentile voltage unbalance level measured over a one-week period shall be within the prescribed planning level. The 99$^{th}$ percentile voltage unbalance level shall be within 1.3x the planning level.

BC Hydro field operations may cause single-phasing conditions on supply feeders when opening or closing individual phases of switching equipment.

Note 8: BC Hydro strongly recommends installing loss-of-phase protection for sensitive customer loads that may be subject to damage from single-phasing conditions. Supply for computers and similar sensitive equipment may require special quality service to buffer against switching transients which may occur on the BC Hydro distribution system.

### 3.6.2 Customer Emission Limits

Customer primary service performance shall comply with BC Hydro emission limit requirements for flicker, rapid voltage changes, unbalance, and harmonic distortion. A customer causing excessive disturbance to a BC Hydro feeder could be faced with service disconnection if they fail to install or enact suitable mitigation. See the following BC Hydro emission limit design standards for more information:

a. ES55 Q4-04 *Rapid Voltage Changes*;

b. ES55 Q4-05 *Voltage Flicker*;

c. ES55 Q4-07 *Voltage Unbalance*; and

d. ES55 Q4-09 *Current Harmonics*.

Primary customers operating below a 0.9 power factor may be subject to additional penalties. Customers should not operate with a leading power factor.

## 3.7 Customer Service Entrance Equipment

BC Hydro accepts the following customer-owned utility types and certified or approved service mains:

a. Ganged loadbreak switch and fuses mounted on the first customer pole;

b. Ganged loadbreak switch mounted on the first customer-owned new class 2 pole and recloser on the second customer pole with the reclose function disabled. See note 23.

c. Ganged loadbreak switch and fuses inside the customer’s primary service switchgear;

d. Fixed breaker with isolation switch inside the customer’s primary service switchgear;

e. Draw-out breakers with lock-out and grounding provisions;

f. Vacuum or $SF_6$ insulated switches, interrupters, and breakers, indoor and outdoor; and

g. Live-front or dead-front equipment.

The customer shall install surge arresters close to the load side of the pole-top loadbreak switch for overhead line primary services. Surge arresters for services with primary revenue metering shall be installed on the metering pole for the most effective protection of the revenue metering cluster (see BC Hydro standard ES43 J7-01 *Primary Revenue Metering*). Surge arresters are not required for services with secondary revenue metering by BC Hydro at the pole-top loadbreak switch provided they are installed at transformer primaries just ahead of BC Hydro meters.

The customer shall install surge arresters on the load side of the service switch for underground primary services that have primary revenue metering. Secondary surge arresters for services with secondary revenue metering are not required by BC Hydro if surge arresters are present on the load side of the primary switch (see drawing PG A1-01 *One Line Diagram Single Radial Supply Typical for U/G Supply Service* in Appendix 1 List of Primary Guide Standards).

Note 9: See 10 Primary Service Protection Requirements for overcurrent protection and coordination requirements.

## 3.8 Primary Service Voltage Conversion Requirements and Procedure

BC Hydro is continuously upgrading and expanding the power distribution grid for improved service reliability and to meet the growing demand for electrical energy. BC Hydro feeders are being upgraded from 12.5 kV to 25 kV, which may require existing customers to upgrade their customer-owned primary service equipment.

Primary service voltage conversion is a major undertaking. BC Hydro will provide minimum six months advance notice of proposed conversions to affected primary customers to allow adequate time for design and construction of the customer service upgrade.

Customer-owned primary service equipment shall meet the requirements for higher primary supply voltage and increased fault level, overcurrent protection, potential rise of ground grid, and step-and-touch voltage requirements per BCEC section 36 *High-voltage installations*. The customer shall follow all steps and obtain the necessary electrical permits, inspections, and approvals described in 5 Submission Procedures. The equipment manufacturer for new services where the customer-owned primary service equipment is initially operated at 12 kV shall supply a certified 12.5 kV to 25 kV conversion kit, containing all components required for conversion to 25 kV supply. This conversion kit shall be stored in a pouch inside the switchgear or in a cabinet mounted on the wall inside the high-voltage primary vault.

## 3.9 Customer-Owned Standby Generation

Customer-owned standby generation is classified as either open-transition (“break-before-make”) or closed-transition (“make-before-break”).

### 3.9.1 Open-Transition Standby Generation

Customer-owned standby generators and transfer switches are regulated and certified to CSA or other applicable standards per TSBC B-E3 071019 3 and are the jurisdiction of TSBC or local AHJ for acceptance of the installation.

Solid state switching devices operating in either open or closed transition are not acceptable.

A customer may operate an open-transition standby generator at primary or secondary voltage as an emergency power supply, independent and disconnected from BC Hydro service. The generator must never operate in parallel with BC Hydro service before or after BC Hydro supply is restored.

The following applies for a secondary voltage manually operated open-transition standby generator:

a. Manufactured manual or automatic transfer switches shall conform to the requirements of CSA C22.2 No. 178.1 *Transfer switch equipment (Trinational standard with NMX-J-674-ANCE and UL 1008)* and shall bear a mark or a label of a certification agency accredited by the Standards Council of Canada, or an approval label issued by an accredited organization under section 10 of the *Safety Standards Act* such as the SPE1000 model code field approval; and

b. The interlock scheme where mechanical key interlocks are used shall be reviewed and accepted by BC Hydro.

A typical interlock scheme for locking out the BC Hydro primary and customer secondary supply is illustrated in Figure 3-1 (locked closed position is indicated with key held captive).

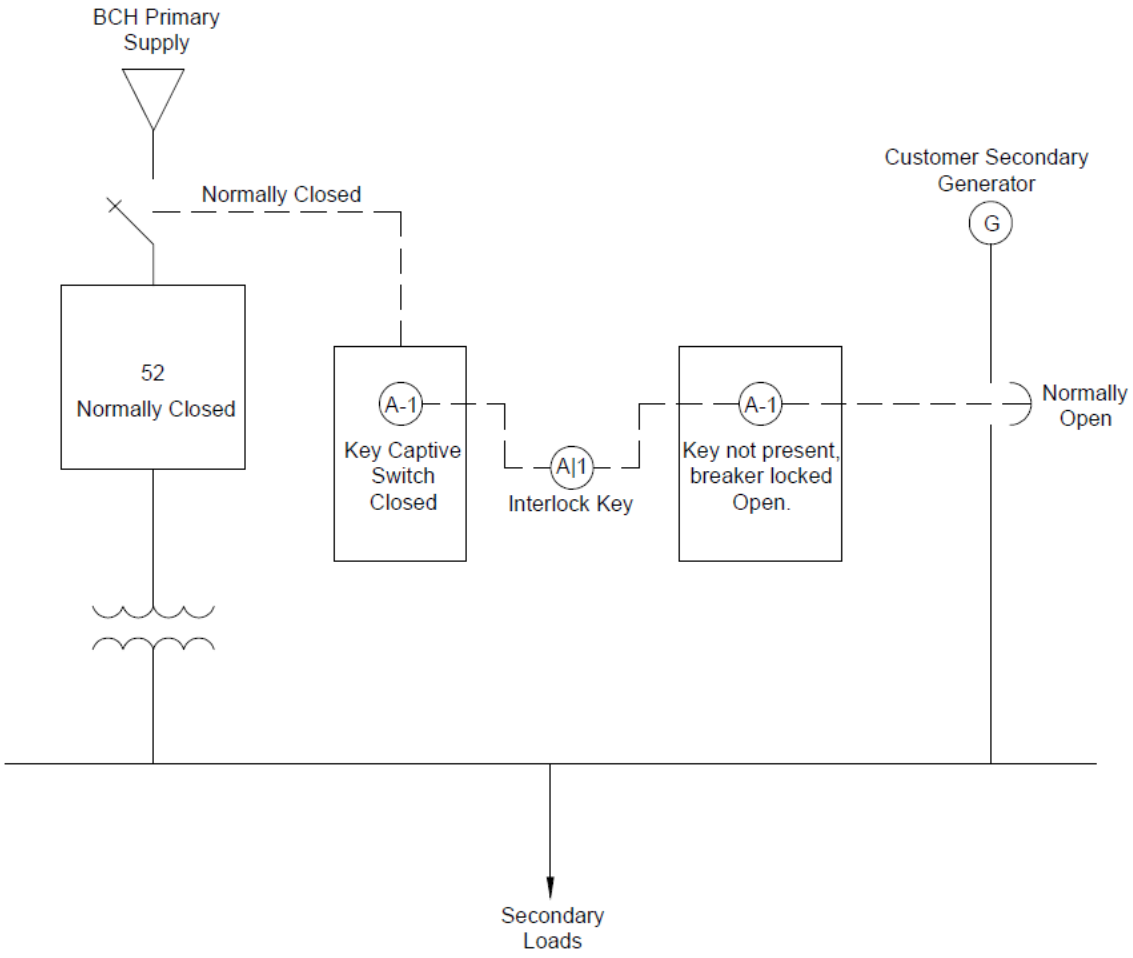



**Figure 3-1** – Typical interlock scheme for locking out BC Hydro primary and customer secondary supply

The following applies for a high voltage manually operated open-transition standby generator:

a. Manufactured manual or automatic transfer switch shall conform to the requirements of CSA C22.2 No. 178.3 *Transfer switch equipment, over 1000 volts (Binational standard with UL 1008A)* and shall bear a CSA Certificate of Compliance to the standard;

b. BC Hydro requires a distribution operating order for safety isolation and disconnection of the BC Hydro utility supply where mechanical key interlocks are used, such as in shopping malls or institutions; and

c. Interlock schemes which include locking out the BC Hydro high-voltage supply shall be reviewed and accepted by BC Hydro.

A typical interlock scheme for locking out the BC Hydro and customer primary supply is illustrated in Figure 3-2 (locked closed position is indicated with key held captive).

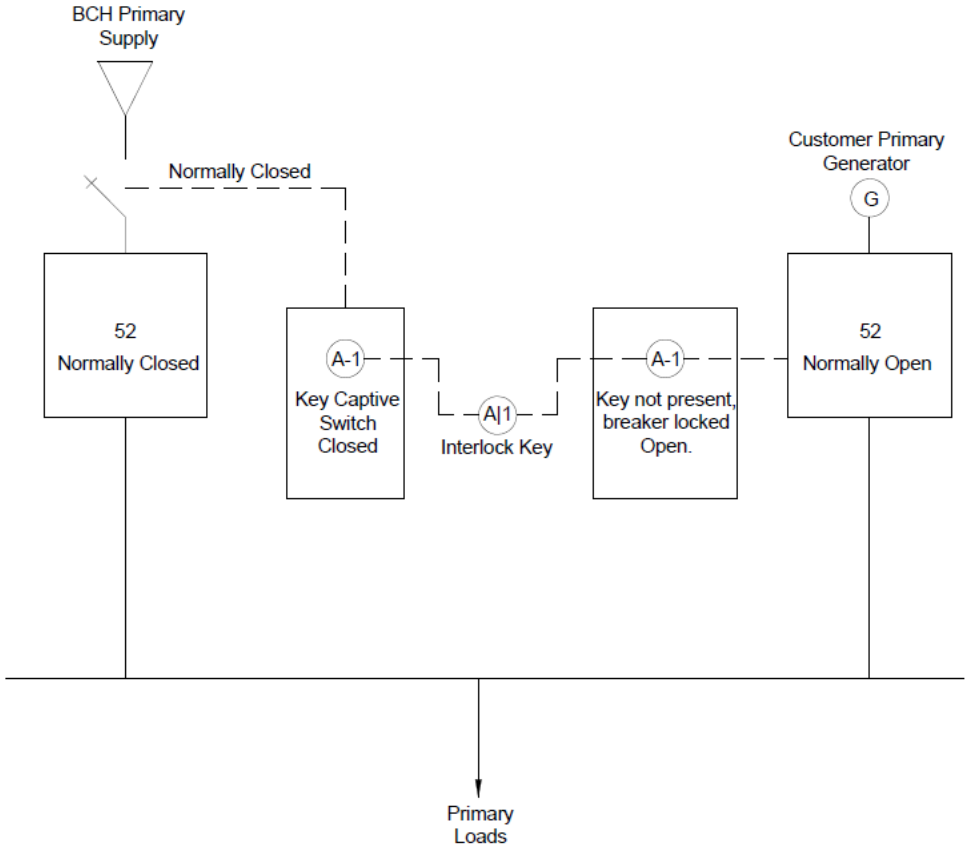



**Figure 3-2** – Typical interlock scheme for locking out BC Hydro and customer primary supply

Manual transfer switches in high or low-voltage installations, field-fabricated or non-manufactured, shall conform to the following:

a. The switching means shall be mechanically held, and the operation shall be by direct manual control or by electrical remote manual control using control power from the supply to which the load is being transferred;

b. A manual transfer switch operated by electrical remote manual control shall include a means for safe manual mechanical operation;

c. Reliable mechanical interlocking (and, in the case of a switch operated by electrical remote manual control, electrical interlocking) to prevent interconnection of the normal and emergency electrical power supply systems shall be inherent in the design of a manual transfer switch;

d. Switches shall include a readily visible mechanical indicator showing the switch position; and

e. Switches shall bear evidence of either a mark or a label of a certification agency accredited by the Standards Council of Canada, or an approval label issued by an accredited organization under section 10 of the *Safety Standards Act* such as the SPE1000 model code field approval.

Mechanical key interlocked devices shall be operated by qualified personnel only.

Essential electrical systems are those for life safety (i.e. fire water pumps, egress systems) and patient care (i.e. hospitals) and are not permitted to use field-fabricated or non-manufactured manual transfer switches per CSA C22.1 section 24.

### 3.9.2 Closed-Transition Standby Generation

A customer may operate standby generation in parallel with BC Hydro supply for up to 20 seconds in a closed-transition transfer. Such parallel operation requires written acceptance from BC Hydro. See the BC Hydro distribution generator interconnections website for application forms, generator interconnection requirements, and the written approval process. Closed-transition transfer requirements can be found in the BC Hydro document *Interconnection Requirements for Closed-Transition Transfer of Standby Generations*.

### 3.9.3 Customer-Owned Non-Standby Generation

A customer may operate non standby/active/continuous generation in parallel with BC Hydro supply (such as grid-tied photovoltaic inverters) with written approval from BC Hydro. Refer to the BC Hydro distribution generator interconnection website for application forms, generator interconnection requirements, and the written approval process.

## 3.10 Maintenance and Testing

The customer is responsible for regular maintenance and testing of their primary service equipment in accordance with manufacturers' recommendations and as required by TSBC to maintain their operating permit. Though BC Hydro personnel do not normally operate customer-owned equipment, operating authority over certain types of equipment (i.e. dead-front services and dual radial services) may be required. If such equipment has not been maintained according to manufacturers' requirements, BC Hydro personnel will not operate the equipment. This may result in prolonged outages or single phasing of the customer's supply. Protective relay settings and operation and circuit breaker operation shall be set and tested by the customer and accepted by BC Hydro before energization. BC Hydro reserves the right to inspect and test the equipment at any time, and to request any necessary maintenance. This inspection does not relieve the customer of their responsibility for equipment maintenance.

WorkSafeBC and BC Hydro safety rules for existing dual radial supply customers require customers owning or managing dual radial vaults to perform maintenance on running and standby circuit switches every 42 months (3.5 years). BC Hydro provides two to three maintenance windows each year to help customers maintain their equipment in a timely manner. The customer is required to conduct maintenance to avoid becoming non-compliant. When maintenance occurs, the customer's electrical contractor shall de-energize the vault in coordination with BC Hydro, disassemble the equipment, clean the components, test the equipment, and coordinate with BC Hydro to re-energize the vault. Maintenance is booked within BC Hydro's pre-determined time windows. All work is carried out by the customer at the customer's expense. See Appendix 2 Reference Documents for more information on dual radial maintenance requests.

The customer primary service space/vault is designated for restricted access to qualified personnel per WorkSafeBC Occupational Health and Safety Regulation Part 19 *Electrical Safety*. The primary service vault shall not be used as a storage room, which can obstruct access to service equipment and hinder emergency egress from the vault. These requirements are explicitly stated in the B.C. Fire Code Regulation, BCEC, and WorkSafeBC regulation (see the 'No Storage Allowed' sign in Appendix 2 Reference Documents.)

## 3.11 Customer Application Process

The customer primary service application and connection procedure is described in the *Primary Service Connections* flowchart in Appendix 2 Reference Documents . Customers are advised to follow the flowchart to expedite application processing.

## 3.12 Fire Protection

BC Hydro exposed primary service cables passing through a fire-rated building wall or partition require the customer to install 4" diameter Hilti CFS-SL GA L firestop speed sleeves, one sleeve for each cable. Other

firestops such as metal duct sleeves filled with spray foam, composite duct seals, or hard cast putty, are not acceptable.

The fire marshall may require a remotely operated shunt trip to be installed on the primary service main for new or existing services. Shunt trip auxiliary assembly and remote pushbutton are acceptable to BC Hydro for this function subject to the following requirements:

a. Retrofit shunt trip installation shall be certified per applicable CSA switchgear standards;

b. Shunt trip assembly shall not hinder visual confirmation of the switch blades and contacts;

c. Shunt trip assembly and operation shall not obstruct padlocking means in open and ground position;

d. Shunt trip mechanism shall not interfere with manual opening of the service main;

e. If the shunt trip assembly fails, such failure shall not interfere with manual opening or closing of the service main;

f. Shunt trip pushbutton shall have a dry-type contact hard-wired into the contactor/breaker trip coil and hard-wired interlock to prevent operation of the contactor/breaker close coil until the trip pushbutton is reset; and

g. The remote shunt trip shall be supplied, installed, and connected by the customer.

h. The remote shunt trip for fire protection shall be located in a readily accessible location as directed by the fire marshall.

# 4 References

Requirements for primary services by the regulatory AHJs at the site contained in this Primary Guide are in addition to the latest revisions of these applicable documents:

1. BC Building Code
2. BCEC;
3. B.C. *Electrical Safety Regulation;*
4. B.C. *Engineers and Geoscientists Act*;
5. BCH-DSR-2015-6043 *Distribution Design Policy – Underground Switchgear;*
6. BC Hydro *35 kV and Below Interconnection Requirements for Power Generators*
7. BC Hydro distribution standards;
8. BC Hydro Distribution Instruction A10-2 *Service Agreements;*
9. BC Hydro *Electric Tariff*;
10. BC Hydro Equipment Advisory 2016-016 *Transfer Switches for Secondary Customer Services Emergency Standby Generators*;
11. BC Hydro Equipment Advisory 2017-002 *Release of ES55 Series Q3 and Q4: Customer Power Quality Emission Limits for Connection to Low- and Medium-Voltage Networks*;
12. BC Hydro *Interconnection Requirements for Closed-Transition Transfer of Standby Generations;*
13. BC Hydro *Requirements for Primary Service Voltage Revenue Metering (4 kV to 35 kV)*;
14. BC Hydro *Requirements for Secondary Voltage Revenue Metering (750 V and less);*
15. BC Hydro *Safety Practice Regulations*;
16. BC Hydro *Statement Regarding Primary Voltage Service Entrance Equipment;*
17. BC Hydro *Technical Interconnection Requirements for Transmission Voltage Customers for Service at 60,000 to 287,000 Volts;*
18. B.C. Ministry of Energy, Mines, and Petroleum Resources; PO Box 9320, Victoria BC, Tel. 250-952-0793;
19. B.C. *Safety Standards Act;*
20. CSA C22.2 No. 0 *General requirements – Canadian Electrical Code, Part II*
21. CSA C22.2 No. 31 *Switchgear assemblies*;
22. CSA C22.2 No. 41 *Grounding and bonding equipment*;
23. CSA C22.2 No. 178.1 *Transfer switch equipment (Trinational standard with NMX-J-674-ANCE and UL 1008);*
24. CSA C22.2 No. 178.3 *Transfer switch equipment, over 1000 volts (Binational standard with UL 1008A);*
25. CSA C22.3 No. 1 *Overhead systems*;
26. CSA C22.3 No. 7 *Underground systems*;
27. CAN-C235-83 *Preferred Voltage Levels for AC Systems, 0 to 50 000 V;*
28. CSA C83-17 *Communication and power line hardware*; and

29. CAN/CSA-IEC C61000-2-2 *Electromagnetic compatibility (EMC) - Part 2-2: Environment - Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems;*
30. CAN/CSA-IEC 61000-4-30 *Electromagnetic compatibility (EMC) — Part 4-30: Testing and measurement techniques — Power quality measurement methods;*
31. IEEE C37.90 *Standard for Surge Withstand Capabilities (SEC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus*
32. IEEE 48 *Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV*
33. IEEE 80-2013 *Guide for Safety in AC Substation Grounding*.
34. IEEE 386 *Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV*
35. National Building Code of Canada;
36. TSBC Directive D-E3 090313 1 *High voltage installations*;
37. TSBC Directive D-E3 070801 7 *Electrical operating permit requirements*;
38. TSBC Directive D-EL 2017-01 *Exemptions to public utilities*;
39. TSBC Information Bulletin IB-EL 2016-02 *High voltage installations;*
40. TSBC Information Bulletin IB-EL 2017-04 *Electrical safety regulation application to public utilities*;
41. TSBC Information Bulletin B-E3 071019 3 *Approved Certification Marks for Electrical Products;*
42. TSBC Information Bulletin B-E3 090312 1 *Overhead line guidelines*;
43. WorkSafeBC Occupational Health and Safety Regulation Part 19 *Electrical Safety*;

# 5 Submission Procedures

## 5.1 Preliminary Design

Customers should visit the BC Hydro website for further resources in addition to the exchange of information described in this section.

### 5.1.1 Customer Submissions

The customer should refer to the guidance for electrical service connections at bchydro.com when applying for a new primary voltage electrical service connection or for alterations or upgrades to an existing primary service requiring an electrical permit per the *Safety Standards Act*. The customer's consultant should have the following information available for submission to a BC Hydro representative:

a. Site plans and drawings;

b. Motors 50 HP and larger in 12.5 kV areas and motors 100 HP and larger in 25 kV areas, and transformers larger than 2 MVA, which may require inrush current mitigation;

c. Harmonic current generating loads, e.g. solid-state drives, rectifiers, uninterruptible power supply, high-efficiency lighting;

d. Flicker generating loads, e.g. arc furnaces, chippers, crushers;

e. Preferred service type (overhead or underground);

f. Total connected load in kVA;

g. Estimated maximum demand in kW per the BC Hydro electric service agreement;

h. Emergency standby generators, as applicable;

i. Service address; and

j. Planned in-service date.

### 5.1.2 BC Hydro Response

The BC Hydro representative will supply the customer with the following information:

a. Primary supply voltage. All new primary service equipment shall be rated and certified for operation at 14.4/25 kV supply;

b. Service type (overhead or underground, radial or dual supply);

c. System impedance and available fault levels at the service point of connection (based on preliminary site plans and drawings);

d. BC Hydro terminal pole, switchgear kiosk, size of fuses or BC Hydro substation feeder relay settings;

e. Expected future supply changes;

f. Details of the BC Hydro electric service agreement;

g. Preliminary status of the available capacity to supply the proposed new load from the existing distribution feeder, demand limits, rapid voltage change limits, flicker emission limits, and harmonic current limits; and

h. Designated space and registered statutory right-of-way on private property for installation of BC Hydro-owned equipment associated with the primary service.

## 5.2 Formal Application

### 5.2.1 Customer Submissions

A customer shall submit a formal application for installation, relocation, or alteration of a primary service. This includes work requiring an installation permit but excludes maintenance work done under an electrical operating permit provided it meets TSBC interpretation of 'maintenance on electrical equipment', per BCEC Rule 2-300 and TSBC Directive D-E3 0708017 *Electrical Operating Permit Requirements*.

The formal application shall include the documents and drawings described in the following sections, authenticated by the professional of record (POR).

Note 10: An incomplete application (including any missing formal declarations) may delay the customer's service date. A BC Hydro representative will process the formal application and endeavour to respond within four weeks.

Note 11: Liability for the design and installation of customer-owned primary service equipment and materials rests with the customer's professional engineer and licensed electrical contractor respectively.

Note 12: The application shall be submitted as a bound PDF copy of multiple individually authenticated documents with an itemized cover letter to ensure direct correlation between individual deliverables and the submission requirements outlined in section 5.2 Two submissions will be required, the first before design commences and the second before design completion and approval.

Note 13: If secondary metering is used, the Primary Service design documents shall encompass all assets up to and including the metering.

#### 5.2.1.1 Before Design Commences

The POR shall submit the following formal application documents before design commences:

a. A completed BC Hydro form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment* (see Appendix 2 Reference Documents) per 5.2.6 Primary Service Declaration;

b. A completed checklist of requirements for customer-owned primary services (see Appendix 2 Reference Documents);

c. An electrical one-line diagram including interrupting rating of protective devices and emergency standby generation as applicable per 5.2.2 Electrical One-Line Diagram;

d. A site plan with equipment and primary vault locations, statutory rights-of-way, minimum clearances from the building, and primary conduit run as applicable per 5.2.4 Site Plan;

e. An overhead line design showing the first customer pole and pole class, service switch and safety mat, fused cutouts and conductor separation at the crossarm, phase conductors, and neutral separation, in compliance with TSBC Information Bulletin B-E3 090312 1 *Overhead line guidelines* and 5.2.5 Primary Service Overhead Line Construction Details; and

f. A protective device coordination graph showing coordination between the customer and BC Hydro protective devices per 5.2.3 Protective Device Coordination Graph.

#### 5.2.1.2 Before Design Completion and Approval

The POR shall submit the following formal application documents before design completion and approval:

a. A primary service equipment drawing including the loadbreak switch or circuit breaker, control wiring diagram, and key interlock scheme, if applicable. If such manufacturer drawings are not available, a BC Hydro representative may complete the review of an incomplete application. BC Hydro shall not authorize the customer primary service connection without approving the primary service equipment fabrication drawings as outlined in 5.3 Primary Service Fabrication Drawings Acceptance;

b. Emission studies. BC Hydro may reqeuest detailed studies for services planned to have loads that may cause electrical disturbances as defined in ES55 power quality standards and referenced in 3.6.2 Customer Emmission Limits, to demonstrate that the customer's operations will not violate emission limits provided in section 5.1.2; and

c. Arc flash hazarad assessment and incident arc energy study for 347/600 V meter installations where the customer owns the transformer that is greater than 1500 kVA.

### 5.2.2 Electrical One-Line Diagram

See drawings PG A1-01 *One Line Diagram Single Radial Supply Typical for U/G Supply Service* and PG A2-01 *One Line Diagram Dual Supply* in Appendix 1 List of Primary Guide Standards.

The electrical one-line diagram shall:

a. Show service entrance equipment including secondary metering, if applicable;

b. Show emergency standby generator connections;

c. Be authenticated and submitted by a POR in good standing with EGBC. The document shall display the permit to practice issued by EGBC;

d. Clearly show cable and conductor sizes up to and including secondary metering, if applicable;

e. Indicate available fault levels at current or future operating voltage as applicable;

f. Show interrupting ratings of the overcurrent protection devices, if not already included in a protection coordination or arc flash study;

g. Include a hazard assessment study;

h. Use industry standard symbols such as IEEE/ANSI, IEC, or include a legend clearly indicating device functionality; and

i. Be signed and sealed with the submission package.

The one-line diagram shall serve as a supplement to the primary service declaration described in 5.2.6 Primary Service Declaration. Contact a BC Hydro representative for primary service cable sizes.

BC Hydro requires the following information from customers regarding emergency standby generation:

a. Rating (e.g. kW, kWe, kVA, kVAR, PF), make, and model of the emergency standby generator and the associated open-transition transfer switch, and a copy of the approval certificate issued by an accredited organization under section 10 of the *Safety Standards Act*, or drawings/manuals that state this equipment is approved by an accredited organization under section 10 of the *Safety Standards Act*; or

b. Rating (e.g. kW, kWe, kVA, kVAR, PF), make, and model of the emergency standby generator and the completed application form and required details for any closed-transition ("bump less") transfer switches per BCEC section 84 *Interconnection of electric power production sources* for review and approval by BC Hydro Distributed Generator Interconnections.

See the BC Hydro document *35 kV and Below Interconnection Requirements for Power Generators* for more information.

### 5.2.3 Protective Device Coordination Graph

The customer shall submit time-current characteristic curves authenticated by the POR in good standing with EGBC and displaying a permit to practice issued by EGBC (see drawing PG D1-01 *Sample Protection Curves Customer Services and BC Hydro* in Appendix 1 List of Primary Guide Standards for an example). The graph shall show:

a. A single time-current characteristic curve with upstream BC Hydro protection, customer relay/fuse curves, and transformer magnetizing inrush;

b. Indicated time margins between the BC Hydro protection and customer entrance protection at the maximum fault level and any other fault level that produces minimum time margin (see 10.1.4 Interrupting Rating and Minimum Time Margins for minimum allowable time margins);

c. Indicated maximum fault levels for bolted three-phase faults (LLL) and single line-to-ground faults (LG) without cutting the curves at those points;

d. A corresponding text box for each curve providing curve details (relay manufacturer, pickup, time dial, curve type, curve modifiers, current transformer ratio, and delay). The customer's total clearing curve shall include the relay/control response time, breaker/recloser interrupting time, and all other propagation and power-up delays; and

e. A standard sized 4½ x 5 cycle log-log graph used for the coordination study. Service entrance protective device settings shall be compatible and coordinate with BC Hydro's protective equipment (see 10 Primary Service Protection Requirements).

Note 14: BC Hydro may request the customer submit complex or illegible coordination graphs on 11"×17" sheets instead of the standard 8½"×11" sheets.

### 5.2.4 Site Plan

The site plan shall show all details of the primary service installation, civil and electrical, overhead or underground plant. The plan shall show the building and the primary service vault locations, the proposed terminal pole or service cable vault (manhole), and routing of the overhead line or underground cables on private property (including inside the customer building) to the point of connection. The site plan shall show BC Hydro road access for line trucks to the first pole and the revenue metering pole. The site plan shall be authenticated by the POR in good standing with EGBC and display a permit to practice issued by EGBC. See 7 Scope of Supply for Primary Services for detailed information and requirements.

The customer shall provide a detailed design layout of primary vaults or outdoor kiosks, showing crew access and emergency escape routes, minimum operating clearances, safety grounding, proposed primary service duct layout, bends, fittings, and pull boxes, as applicable. See 8 Primary Service Construction for more details on underground service requirements.

### 5.2.5 Primary Service Overhead Line Construction Details

The customer shall submit engineering drawings of construction details for a privately-owned overhead line to BC Hydro for acceptance before constructing the line. The drawings shall be authenticated by the POR registered with EGBC and displaying a permit to practice issued by EGBC. The construction details shall not reference or include BC Hydro standards except where required as supply authority, such as for primary revenue metering. The engineering drawings shall include the following minimum design details per TSBC Information Bulletin B-E3 090312 1 *Overhead line guidelines,* and BC Hydro requirements:

a. First customer pole shall be a new dedicated minimum class 2 pole (no customer equipment), independently anchored by customer guying and anchoring (if required), double dead-ended, crossarms and gang-operated loadbreak service switch, and fused cutouts;

b. Gradient control mat, ground electrodes, and switch grounding details;

c. Conductor separation at the crossarm, phase conductors and neutral separation, neutral conductor attachment separation to ground;

d. Fused cutouts (or recloser) mounting details and minimum clearances between devices on the pole;

e. Revenue metering pole shall be a new class 2 pole per BC Hydro ES43 standards; and

f. Pole mounting hardware and components shall be certified to CSA C83 *Communication and power line hardware*.

To avoid project delays and field modifications of the customer-owned overhead line, the customer shall not commence construction until all drawings and information have been reviewed and accepted by a BC Hydro representative, typically within four weeks from the date of receipt. See Appendix 3 Photographs for a visual reference of overhead line construction examples.

### 5.2.6 Primary Service Declaration

The customer shall complete the BC Hydro form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment* (also known as the primary service declaration). This form shall be authenticated by the POR registered with EGBC and display a permit to practice issued by EGBC. See Appendix 2 Reference Documents for a sample declaration.

## 5.3 Primary Service Fabrication Drawings Acceptance

The customer shall submit fabrication drawings for the proposed primary service switchboard or drawings for a proposed primary service kiosk to a BC Hydro representative for comment and acceptance prior to manufacturing. A BC Hydro representative will issue a response letter and return the referenced drawings to the customer with applicable comments and a confirmation of acceptance.

To avoid costly changes and field modifications, manufacturing of the customer-owned equipment should not commence until all drawings and information have been accepted by the POR and accepted by a BC Hydro representative, typically completed within four weeks from the date of receipt.

BC Hydro is particularly concerned with public and BC Hydro personnel safety. The customer-owned primary service equipment shall be designed, manufactured, and installed to meet all pertinent regulations including, but not necessarily limited to, those of:

a. WorkSafeBC regarding safe working space, operating access, and electrical clearances;

b. BC Hydro *Safety Practice Regulations* for grounding details, limits of approach, barriers for energized conductors, interlock schemes, and lockout provisions; and

c. CSA, TSBC, and local inspection authorities as AHJ for the site.

Note 15: Supply service cable pull boxes and primary service switchboard cells, cubicles, and compartments for the exclusive use of and with access restricted to BC Hydro personnel, shall be equipped with a padlocking hasp and BC Hydro security bolts, or other security restraining means with sealing provisions as determined by a BC Hydro representative.

The primary service switchboard or kiosk drawing shall show the following:

a. Fully dimensioned switchboard compartments and details, showing access doors and locking provisions;

b. Ground bus layout, equipment grounding pads, and grounding ball studs;

c. Primary service cable compartment and cable termination provisions (see BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation*, ES54 S3-02 *Primary Services Live-Front Outdoor Kiosk Private Property Installation*, and ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*;

d. Main switch or a breaker switchboard compartment;

e. Circuit breaker and protective relaying wiring diagram, as applicable;

f. Interlocking diagram, equipment nameplates, and warning signs; and

g. Primary or secondary revenue metering compartment or switchboard compartment.

Contact a BC Hydro representative for further design and installation details and review the relevant BC Hydro distribution standards and other sections of this Primary Guide.

## 5.4 High-Voltage Commissioning Report and Authorization for Connection

The customer shall submit a high-voltage commissioning report authenticated by the POR before the final connection authorization inspection, containing the following:

a. Protective relaying study;

b. Grid potential rise, step-and-touch grounding report, as required by BCEC section 36 *High-voltage installations*. Overhead switches, reclosers, and transformer pole gradient grounding mats may be exempted by the AHJ (see 7.2 Customer Scope of Supply for Overhead Service Connections). Revenue metering grounding mats are exempted by BC Hydro;

c. Service switch or breaker test report and indication that the device bears a mark or label of a certification agency accredited by the Standards Council of Canada, or an approval label issued by an accredited organization under section 10 of the *Safety Standards Act* such as the SPE1000 model code field approval;

d. Protective relaying test report confirming the device margins indicated in 5.2.3 Protective Device Coordination Graph and trip time at maximum LG and LLL fault levels recorded by injecting primary or secondary test current;

e. Transformer production and commissioning test report for substations, including an oil analysis report, if applicable, and indication that the device bears a mark or label of a certification agency accredited by the Standards Council of Canada, or an approval label issued by an accredited organization under section 10 of the *Safety Standards Act* such as the SPE1000 model code field approval, except where provided by BC Hydro;

f. High-voltage cable commissioning test report for service connections involving customer installed cables between the BC Hydro device and customer service entrance equipment if applicable;

g. Record drawings per 5.2 Formal Application and 5.3 Primary Service Fabrication Drawings Acceptance. Each record drdawing shall have an “As constructed” stamp. Only record drawings that contain changes to the engineering content not previously issued in an authenticated document shall be reauthenticated.

h. Final inspection certificate from the site inspection AHJ. If a local authority waives the final inspection, BC Hydro shall accept the certificate of site inspection as confirmation of compliance with the BCEC;

i. Contractor declaration along with evidence the inspection has been waved, as confirmation the primary service is completed in compliance with B.C. regulations and the *Safety Standards Act*;

j. A letter stating that submitted documents are in compliance with BC Hydro requirements and meet the original design intent of 5.2 Formal Application as originally accepted by BC Hydro, or if different, indicate what changed and the reason for the deviations; and

k. The submission package for the high-voltage commissioning report and authorization for connection shall be complete, containing all relevant documents. Incomplete packages will be returned.

Note 16: The customer shall provide certified test results reviewed by the POR if used equipment is installed in the customer-owned primary service that authenticate the proposed equipment was tested in accordance with TSBC Information Bulletin B-E3 071019 3 *Approved Certification Marks for Electrical Products* and is suitable for connection to the BC Hydro distribution system.

Note 17: The owner is responsible for damage to BC Hydro equipment resulting from a malfunction or improper installation of customer primary service equipment including transfer switch and standby generator.

## 5.5 Primary Service Voltage Conversion Requirements and Procedure

See 3.8 Primary Service Voltage Conversion Requirements and Procedure.

## 5.6 Dead–Front Primary Services

See 9.19 Dead-Front Switchgear.

## 5.7 Temporary Power as Primary Service

Customer-owned primary services shall meet the requirements for BC Hydro primary distribution supply voltage and available fault level, overcurrent protection, potential rise of ground grid, and step-and-touch voltage requirements per BCEC section 36 *High-voltage installations*. A customer applying for connection of temporary primary service shall follow the steps and obtain necessary electrical permits, inspections, and approvals described in 5 Submission Procedures.

Note 18: A temporary service shall meet the requirements of this Primary Guide applicable to permanent primary services.

# 6 BC Hydro Primary Distribution System

## 6.1 Preliminary Design

BC Hydro will determine the customer's service voltage.

### 6.1.1 Primary Supply Voltage

Almost all BC Hydro primary service connections are fed from the BC Hydro primary voltage distribution system, comprising a three-phase four-wire multi-grounded neutral system. Some smaller primary services may be supplied by single-phase two-wire multi-grounded neutral. BC Hydro primary distribution voltages are:

a. 4 kV: 2400 V / 4160 V grounded wye (currently being phased out);

b. 7.2 kV: single phase;

c. 12.5 kV: 7200 V / 12,470 V grounded wye;

d. 14.4 kV: single phase;

e. 25 kV: 14,400 V / 24,940 V grounded wye; and

f. 35 kV: 19,920 V / 34,500 V grounded wye (used in some rural applications in the Central Interior region of Northern B.C. and only available as overhead service).

System frequency is 60 Hz ± 0.1 Hz. Primary voltages may be designated in this guide by their nearest whole number (e.g. a nominal voltage of 25 kV corresponds to 14,400 V / 24,940 V grounded wye).

### 6.1.2 Secondary Supply Voltage

BC Hydro will supply secondary voltage service as described below. If the customer requires service at a different voltage or if it is not feasible for BC Hydro to install the equipment required for secondary service, primary service may be offered as determined by BC Hydro. The customer shall contact a BC Hydro representative to determine their service voltage before designing their electrical room and purchasing service equipment.

Following are the maximum customer service switch sizes rated for 80% continuous operation to be supplied by BC Hydro at secondary distribution voltage in areas where primary service voltage is either 12 kV or 25 kV.

#### 6.1.2.1 Overhead

The maximum customer service switch sizes rated for 80% continuous operation are:

a. 600 A at 1Ø 3-wire 120 V / 240 V;

b. 400 A at 3Ø 4-wire 347 V / 600 V; and

c. 800 A at 3Ø 4-wire 120 V / 208 V.

#### 6.1.2.2 Underground

The maximum customer service switch sizes rated for 80% continuous operation in areas where the primary service voltage is 12.5 kV (may include areas that are designated for 25 kV), are:

a. 600 A at 1Ø 3-wire 120 V / 240 V;

b. 1600 A at 3Ø 4-wire 120 V / 208 V; and

c. 600 A at 3Ø 4-wire 347 V / 600 V.

The maximum customer service switch sizes rated for 80% continuous operation in areas where the primary service voltage is 25 kV are:

a. 600 A at 1Ø 3-wire 120 V / 240 V;

b. 1600 A at 3Ø 4-wire 120 V / 208 V; and

c. 1600 A at 3Ø 4-wire 347 V / 600 V.

In some rural applications where the primary service voltage is 19,920 V / 34,500 V grounded wye, the maximum consumer service switch sizes rated for 80% continuous operation to be supplied by BC Hydro at the secondary distribution voltage are:

a. 600 A at 1Ø 3-wire 120 V / 240 V;

b. 1600 A at 3Ø 3-wire 120 V / 208 V; and

c. 600 A at 3Ø 4-wire 347 V / 600V.

Please contact a BC Hydro representative for further details and 100% rated services and main switches.

## 6.2 Service Transformers

### 6.2.1 Supply of Service Transformers

BC Hydro can supply and install the necessary transformers for secondary voltage service. The customer shall supply and install required customer-owned transformers for primary voltage service. BC Hydro may supply standard overhead transformers up to 167 kVA per phase if requested by the customer for overhead primary service in rural or industrial areas, per the BC Hydro *Electric Tariff*.

Note 19: Parallel connection of BC Hydro transformers is not permitted.

### 6.2.2 Primary Service Transformer Connections

The customer-owned transformer connections accepted by BC Hydro are:

a. Grounded wye – grounded wye: Primary and secondary transformer neutrals shall be connected, solidly grounded to the station ground, and connected directly to the BC Hydro service system neutral to minimize neutral voltage rise caused by load imbalance. This is the BC Hydro preferred connection for better ground fault protection and safety of operating personnel.

b. Delta – grounded wye: This connection is common for factory-built unit substations with dry-type transformers and a solidly grounded wye point. Ferroresonance could be a problem, as with all ungrounded primary transformer connections, as voltage feedback will occur when one primary phase opens.

c. Delta – resistance grounded wye: This connection is preferred for limiting damage to sensitive electronic equipment caused by line-to-ground faults. Mission critical production machinery can continue to operate in the presence of a line-to-ground fault until a planned shutdown. In this configuration, secondary windings are relatively disconnected from the station ground, and large service transformers could exhibit problems such as overvoltage feedback from the primary side and ferroresonance if any one primary phase would open circuit.

d. Ungrounded wye – delta: The transformer primary neutral is floating and insulated to the service potential to avoid overvoltage feedback and single-phasing problems. Each single-phase transformer requires two primary bushings, and primary voltage could be present on this floating neutral under certain conditions, for example one phase open caused by a blown primary fuse.

e. Delta – delta: Two-bushing transformers are required for a three-phase bank of single-phase transformers. If one phase of the primary line opens, a backfeed voltage approximately equal to one-

half line-to-line voltage will be impressed on the open phase. Ferroresonance may result, as with all ungrounded primary connections.

BC Hydro recommends the customer seek the advice of a professional engineer regarding the type of transformer connection to best suit their plant operation, specific load requirements, and ground fault protection scheme.

Alteration of neutral/grounding scheme or non-standard installation is not permitted where BC Hydro supplied transformers will be used.

### 6.2.3 Service Neutral Connections

The BC Hydro service neutral will terminate at the the service neutral/ground bus in the utility service entrance compartment in accordance with clause 6.9 of CSA C22.2 No. 0 *General requirements – Canadian Electrical Code, Part II*.

The customer's neutral where primary voltage revenue metering is installed shall be insulated, single-point bonded, and extended to the:

a. Pole-mounted metering kit for overhead line construction with a pole-top metering kit; or

b. Revenue metering instrument transformer compartment if primary switchgear is used.

See the BC Hydro document *Requirements for Primary Service Voltage Revenue Metering (4 kV to 35 kV)* for more information.

### 6.2.4 Transformer Taps

BC Hydro recommends that customer-owned transformers use industry-standard two 2.5% primary taps above and below rated voltage. The BC Hydro system operates within the voltage range specified in CSA C235-83 *Preferred voltage levels for AC systems up to 50,000 V*. The use of taps on the customer's transformer will allow the customer to adjust the voltage as required at the point of utilization.

### 6.2.5 Maximum Connected Transformer Size and Limitations

Customer-owned transformer inrush current levels shall coordinate with the BC Hydro upstream protective device (recloser, fuse, or relay) during the energization transition period. Customers may be required to install equipment that mitigates inrush current where coordination with a BC Hydro upstream protective device is not achievable due to high transformer inrush current.

The customer entrance protection may inadvertently trip on transformer inrush or cold load pickup (CLPU) current depending on the size of customer-owned transformers or load. The customer entrance protection shall coordinate with the upstream BC Hydro protective device. The customer may not be able to increase pickup or reduce time margins to avoid mis-coordination. Transformer sizes and loading may be a technical limitation for the customer design, especially if mitigation to reduce inrush and CLPU current is not applied.

Customers shall meet emissions limits as prescribed in 3.6.2 Customer Emission Limits.

# 7 Scope of Supply for Primary Services

## 7.1 BC Hydro Scope of Supply for Overhead Service Connections

BC Hydro normally supplies and installs the following for a primary overhead service connection:

a. Fused cutouts on the supply end of the primary service connection;

b. Fuse links for overcurrent protection of the BC Hydro primary service conductors, or solid links and BC Hydro feeder protective relaying for large primary services; and

c. Primary overhead service conductors and the primary service connection to the customer-owned loadbreak switch located on the first customer-owned pole.

Note 20: BC Hydro may install a dedicated recloser for improved service reliability for all customers and request the customer to coordinate new customer primary service protection relays with BC Hydro dedicated recloser relays.

Note 21: The location of the first customer-owned pole as the point of delivery shall be selected in agreement with BC Hydro. The pole lines on private property, riser/dip pole, and customer-owned unit substations are installed, owned, and maintained by the customer under the jurisdiction of TSBC or other AHJ.

BC Hydro requirements on private property extend to the installation of primary or secondary revenue metering, which shall comply with BC Hydro metering requirements and 6 BC Hydro Primary Distribution System.

BC Hydro supplies the following equipment for installation by the customer's licensed electrical contractor:

a. An outdoor primary revenue metering cluster, complete with a pole-mounting bracket for primary revenue metering, two surge arresters for single-phase primary metering, and six surge arresters for three-phase primary metering; or

b. Switchgear secondary revenue metering transformers for secondary revenue metering.

Note 22: A pole-mounted overhead primary revenue metering kit is a costly option which will be charged to the customer as a cost of service connection. BC Hydro prefers secondary revenue metering, which is less costly and requires less maintenance.

## 7.2 Customer Scope of Supply for Overhead Service Connections

BC Hydro requires the customer to install the following materials and equipment for primary overhead services with pole-mounted primary revenue metering:

a. A loadbreak switch and safety ground mat on the first pole per drawing PG A1-02 *One Line Diagram Single Radial Supply Typical for O/H Supply Service* (see Appendix 1 List of Primary Guide Standards) and TSBC Directive D-E3 090313 1 *High voltageinstallations.* The loadbreak switch shall comply with 10.3.2 Loadbreak Switch;

Note 23: The authenticated grounding report for the safety ground mat at the first customer-owned pole loadbreak switch may be exempted by the AHJ if the installation complies with C22.1 section 36-302.

b. Overcurrent protection by means of fuses or a circuit breaker on customer-owned unground service conductors, per BCEC Rule 36-204 *Overcurrent protection*. A loadbreak switch requires fused cutouts on the first pole to meet the applicable rule;

Note 24: An exception to (b) applies if the customer chooses to install a utility-type recloser with the reclose function defeated as customer-owned overcurrent protection. BCEC rule 36-204 1

does not recognize a recloser as an acceptable means of providing overcurrent protection for a consumer service. In this configuration, a variance shall be obtained from TSBC and submitted to a BC Hydro representative to demonstrate AHJ acceptance of this equipment. The recloser shall be installed on the second customer-owned pole and the BC Hydro primary metering kit shall be installed on the third customer-owned pole (see drawing PG A1-02 *One Line Diagram Single Radial Supply Typical for O/H Supply Service* in Appendix 1 List of Primary Guide Standards). The customer could omit fuses on the first pole subject to a variance granted by TSBC.

c. A BC Hydro primary revenue metering kit on the second customer-owned pole, and completion of the primary line and load-side connections. To minimize the effect of transient switching surges and lightning strikes, the customer shall install 18 kV rated surge arresters for 12.5 kV and 25 kV supply and 27 kV rated surge arresters for 34.5 kV rural supply. The customer may choose to use 9 kV arresters for 12 kV supply but will require replacement with 18 kV for future 25 kV distribution feeder voltage upgrades. Arresters shall be installed near the primary revenue metering apparatus per BC Hydro ES43 J7 primary revenue metering standards; and

d. A safety ground mat on the second pole below the BC Hydro revenue metering cabinet per BCEC Rule 36-310 *Gang-operated switch handle grounds* and BC Hydro standard ES43 R3-05 *Bonding and Grounding Equipment Three-Phase Primary Metering*. Grounding mats installed per BC Hydro standards and for operation of BC Hydro equipment are exempt from grounding reports.

## 7.3 BC Hydro Scope of Supply for Underground Service Connections

BC Hydro will supply and install the following for underground primary service connections:

a. Primary supply service cables (pulled into customer-owned service ducts);

b. Cable support clamps;

c. Duct seals, as necessary;

d. Padlocks to secure utility-restricted equipment;

e. Equipment identification and safety decals;

f. Corresponding service cable terminations installed inside the utility supply service cable compartment of the customer-owned primary service switchboard as the point of connection; and

g. Grounding, bonding, and neutral connections for BC Hydro equipment (service cables and terminations).

BC Hydro will supply and install BC Hydro-owned and operated automated switches in areas designated by BC Hydro for underground primary open loop service for loads not exceeding 6.5 MVA in a 7.2/12.5 kV area, and a junction box for loads not exceeding 1.5 MVA in a 7.2/12.5 kV area. See BC Hydro standards ES54 E3-04 *Below Ground Switchgear BC Hydro Vault on Private Property,* ES54 E4-04 *Above Ground Switchear BC Hydro Vault on Private Property,* or ES54 E6-01 *BC Hydro Switchgear Vault in Customer-Owned Building Single Radial Supply*. The service connection for large customer loads or service requiring standby supply from another feeder shall follow BC Hydro standard ES54 E6-02 *BC Hydro Switchgear Vault in Customer-Owned Building Dual Supply*.

BC Hydro will supply the following equipment for installation by the customer's licenced electrical contractor for primary underground services:

a. Switchgear primary revenue metering transformers for the primary revenue metered service; or

b. Switchgear secondary revenue metering transformers for the secondary revenue metered service.

BC Hydro requirements on private property extend to the installation of primary or secondary revenue metering, which shall comply with BC Hydro revenue metering requirements and 6 BC Hydro Primary Distribution System.

Note 25: Revenue metering equipment and necessary conduits shall be installed by the customer. Control and interconnection wiring is supplied and installed by BC Hydro.

After receiving a formal application, BC Hydro will determine the most suitable form of underground service in consultation with the customer, based on the designated BC Hydro primary distribution circuit:

a. Single radial supply: Comprising the incoming cable termination and a gang-operated disconnect or loadbreak switch per drawing PG A1-01 *One Line Diagram Single Radial Supply Typical for U/G Supply Service* (see Appendix 1 List of Primary Guide Standards). The maximum transformer size is defined by the upstream protective device the transformer coordinates with (see 6.2.4 Transformer Taps).

b. Primary service dual supply: Comprising two radial supplies per drawing PG A2-01 *One Line Diagram Single Radial Supply Typical for O/H Supply Service* (see Appendix 1 List of Primary Guide Standards). This configuration may be required for:

   i. High-reliability primary services with a standby feeder;

   ii. Large loads exceeding the limits stated in (a), in consultation with a BC Hydro representative; or

   iii. Other customer special requests (e.g. dedicated standby supply).

The procedure for transferring customers from the normal feeder to the standby feeder for primary service dual supply with one supply as standby involves momentarily paralleling both circuits in the customer's vault. Contact a BC Hydro representative for a detailed description of the switching procedure, which may require a distribution operating order.

## 7.4 Customer Scope of Supply for Indoor Primary Service Vaults

Service ducts (conduits), pull boxes, and pull pits on private property shall be designed and installed by the customer in accordance with BC Hydro ES54 underground civil construction standards and TSBC requirements or the *Safety Standards Act*, as appropriate, with reference to CSA C22.3 No. 7 *Underground systems*.

The extent of service cable runs on private property shall be kept to a minimum to reduce the possibility of cable damage and subsequent collateral supply disturbance to other services fed from the same circuit.

The customer shall supply and install the following, as applicable:

a. A primary service vault meeting the requirements of 8 Primary Service Construction;

b. A primary service vault access door key for direct exterior access per 8 Primary Service Construction;

c. Cable ducts, conduits, and fittings on the customer’s property;

d. Engineered structural supports for the service cable ducts;

e. Metal cable pull boxes with hinged cover doors per 8 Primary Service Construction;

f. A remote shunt trip pushbutton and related accessories (e.g. tamperproof enclosure) per 8 Primary Service Construction;

g. A primary service switchboard meeting the requirements of 9 Primary Service Switchboard Construction;

h. For primary metered overhead services, BC Hydro shall supply and the customer shall install 18 kV rated surge arresters for 12 kV and 25 kV supply, or 27 kV arresters for rural 34.5 kV supply. The customer may choose to use 9 kV arresters for 12 kV supply but will require replacement with 18 kV for future 25 kV distribution feeder voltage upgrades; and

i. For primary metered underground services, the customer shall supply, own, and install 18 kV rated surge arresters for 12 kV and 25 kV supply, or 27 kV arresters for rural 34.5 kV supply. The customer may choose to use 9 kV arresters for 12 kV supply but will require replacement with 18 kV for future 25 kV distribution feeder voltage upgrades.

### 7.4.1 BC Hydro Supply Point Located Inside Customer Building

The customer shall construct an appropriately prepared electrical space for primary services requiring a BC Hydro switchgear room inside the customer building per BC Hydro standards ES54 E6-01 *BC Hydro Switchgear Vault in Customer-Owned Building Single Radial Supply* for single radial supply and ES54 E6-02 *BC Hydro Switchgear Vault in Customer-Owned Building Dual Supply* for dual supply.

The BC Hydro supply service cables shall run between the BC Hydro switchgear vault and the customer primary service vault as the BC Hydro supply point is located inside the customer building. These supply service cables are typically cut outside the building by BC Hydro crew and transported into the vault for installation by hand. BC Hydro can only deliver hand coils of cable due to the restricted height of 2.1 m, which limits the maximum service cable and duct length to 10 m. The customer primary service vault shall therefore be located within 10 m of the BC Hydro switchgear vault. If the customer locates a primary service vault more than 10 m from the BC Hydro switchgear room, BC Hydro requires a minimum vehicle access clearance of 4 m (13’1") to facilitate larger cable handling vehicles.

## 7.5 Customer Scope of Supply for Outdoor Primary Service Kiosks

Service ducts (conduits) and pull boxes on private property shall be designed and installed by the customer in accordance with BC Hydro ES54 underground civil construction standards and TSBC requirements or the *Safety Standards Act*, as appropriate, with reference to CSA C22.3 No. 7 *Underground systems*.

The extent of service cable runs on private property shall be kept to a minimum to reduce the possibility of cable damage and subsequent collateral supply disturbance to other services fed from that same circuit.

The customer shall supply and install the following:

a. A concrete pad for the primary service kiosk with duct window and conduit stubs located to align with the utility service cable compartment bus bars or service bushings;

b. A BC Hydro 832 box or 1232 box per 8 Primary Service Construction;

c. Primary service cable ducts and pull boxes located on the customer’s property;

d. A primary service kiosk meeting the requirements of 9 Primary Service Switchboard Construction; and

e. 18 kV rated surge arresters for 12 kV and 25 kV supply, or 27 kV arresters for rural 34.5 kV supply. The customer may choose to use 9 kV arresters for 12 kV supply but will require replacement with 18 kV for future 25 kV distribution feeder voltage upgrades.

Note 26: The power supply for loads inside the service kiosk, such as heaters, relays, lights, and convenience plugs, shall be connected after the revenue metering point. The customer is required to show this type of dedicated supply circuit on the one-line diagram.

## 7.6 Customer Scope of Supply for Primary Revenue Metering Kiosks

The customer may opt to install a primary service revenue metering kiosk outside their primary service vault or private overhead line as a designated demarcation structure and a point of connection, with BC Hydro's acceptance. This configuration may be suitable for distributed industrial plants with multiple distribution transformers or large strip malls, or for special installations requiring restricted access to BC Hydro personnel on private property.

A primary service metering kiosk shall include requirements and equipment listed in 7.5 Customer Scope of Supply for Ourdoor Primary Service Kiosks, with the addition of a primary revenue metering cubicle as described in 3.5 Revenue Metering. The revenue metering cubicle shall have a mechanical key interlock with a primary service main on the line side and on the customer switch, or a breaker on the load side as applicable, for safe access into the metering cubicle when the switches are locked out in the off position.

The customer shall supply and install 18 kV rated surge arresters for 12 kV and 25 kV supply, or 27 kV arresters for rural 34.5 kV supply. The customer may choose to use 9 kV arresters for 12 kV supply but will require replacement with 18 kV for future 25 kV distribution feeder voltage upgrades. Arresters shall be installed on the load side of the service main for the protection of BC Hydro revenue metering transformers.

# 8 Primary Service Construction

## 8.1 General

Customer-owned high-voltage installations shall comply with the applicable rules and regulations of TSBC, BCEC, and any other regulatory AHJ at the site in question. BCEC rules require the following:

a. Rule 36-000 *Scope*, paragraph (2): “The supply authority and the inspection department must be consulted before proceeding with any such installation”;

b. Rule 36-200 *Service equipment location*: “Service equipment shall be installed in a location that complies with the requirements of the supply authority and, in the case of a building, shall be at the point of service entrance”;

c. Rule 36-202 *Rating and capacity*, paragraph (b): “The type and ratings of circuit breakers, fuses, and switches, including the trip settings of circuit breakers and the interrupting capacity of overcurrent devices, shall be in compliance with the requirements of the supply authority for consumer’s service equipment”; and

d. Rule 84-002 *General requirement*: “The interconnection arrangements shall be in accordance with the requirements of the supply authority”.

BC Hydro primary distribution systems are engineered and constructed in accordance with authenticated BC Hydro distribution standards. Customer-owned primary services connected directly to the BC Hydro distribution system shall be engineered and certified to be compatible with the system. Certification shall include electrical equipment, support structures, the method of primary service connection, and service isolation, to ensure public safety and the safety of BC Hydro personnel. Customer-owned primary installations shall be installed by a class A licensed electrical contractor, registered and licensed by TSBC.

Note 27: BC Hydro may disconnect the primary service if customer-owned equipment poses a safety or operational risk to the BC Hydro distribution system, until the issue has been resolved to BC Hydro’s satisfaction.

Primary services shall be built to accommodate 14.4/25 kV primary supply, even if BC Hydro supply in the area may currently be 7.2/12 kV. This requirement is intended to minimize impacts related to future supply voltage conversion from 7.2/12 kV to 14.4/25 kV.

Contact a BC Hydro representative for the service area for more information.

### 8.1.1 Underground Services

BC Hydro will supply and install primary service cables, cable terminations, and related accessories from the BC Hydro point of supply to the customer point of connection, per 7.3 BC Hydro Scope of Supply for Underground Service Connections. New BC Hydro primary supply service cables are extruded dielectric. Paper-insulated lead-covered (PILC) cables are no longer installed for supply service.

BC Hydro shall determine the number and size of cables and conduits required based on the information received about the load profile and size of the primary service. Contact a BC Hydro representative for detailed information about underground cables and installation costs.

#### 8.1.1.1 Cable Protection

Utility supply service cables shall be housed entirely within ducts, utility-only access pull boxes, a restricted utility-only access cable pull pit, or a supply service cable compartment. Service ducts located on walls inside a building shall be protected by suitable metal covers or metal bollards.

#### 8.1.1.2 Cable Terminations

BC Hydro will supply and install the following supply service cable terminations depending on the type of service equipment:

a. Live-front cable terminations for extruded dielectric cables, meeting the requirements of IEEE 48 *Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV* and BC Hydro equipment specifications; or

b. Dead-front 900 A separable insulated connectors, meeting the requirements of IEEE 386 *Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV* and BC Hydro equipment specifications per BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation* or ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*, as applicable.

Note 28: Supply service cables shall enter the primary supply service cable compartment from the bottom. Cable terminations shall be installed and secured in an upright vertical orientation. BC Hydro will not accept inverted cable connections or inverted cable terminations.

#### 8.1.1.3 Cable Support

The supply service cable compartment shall include a 1⅝" x"1⅝" C-channel mounted above the centreline of the supply service cable ducts to support the service cables positioned in the upward or forward (outward) facing orientation. The orientation shall be readily adjustable by the BC Hydro installer. The mounting provision attachment surface shall be aligned with the service duct and the contact surface of the service bus/bushings, and shall be adjustable from this point (minimum +15 mm forward and -75 mm backward). Cable support fixtures (cable clamps or cable positioning brackets) shall be supplied and installed by BC Hydro. The supply service cable compartment shall be designed and constructed in accordance with BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation*, ES54 S3-02 *Primary Services Live-Front Outdoor Kiosk Private Property Installation*, or ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*, as applicable.

#### 8.1.1.4 Padlocks

BC Hydro standard padlocks have a ⅜″ diameter shackle, 1" horizontal clearance, and 1" vertical clearance.

### 8.1.2 Overhead Services

BC Hydro is developing new standards for overhead primary customer-owned service connections, to be published in a future Primary Guide revision. In the interim, see 5.2.5 Primary Service Overhead Line Construction Details and 7.2 Customer Scope of Supply for Overhead Service Connections. BC Hydro's main safety concern is that customers supply and install new class 2 poles for the first service pole and primary revenue metering pole.

## 8.2 Service Ducts

Service ducts (conduits) on private property shall be installed by the customer in accordance with BC Hydro ES54 underground civil construction standards and TSBC requirements or the *Safety Standards Act*, as appropriate, with reference to CSA C22.3 No. 7 *Underground systems* and the requirements of other AHJs at the site.

The extent of service cable runs on private property shall be kept to a minimum to reduce the possibility of cable damage and subsequent collateral supply disturbance to other services fed from the same circuit.


**Figure 8-1** – BC Hydro underground duct marker board

Note 29: A BC Hydro representative may request the customer to install cable marker boards (Figure 8-1, 450 mm x 1000 mm x 12 mm) for any portion of the underground service duct run on private property with a high risk of future potential damage from dig-ins.

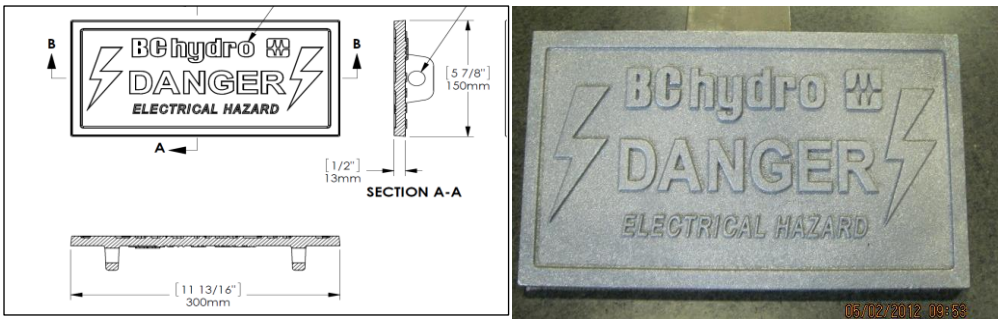



**Figure 8-2** – BC Hydro primary cable warning plate

Note 30: Permanent cast iron warning plates (Figure 8-2) shall be installed for any portion of the primary service where ducts are embedded inside customer concrete building walls, floor slabs, or parkades. Warning plates are stipulated by BCEC Rule 36-100 *Conductors*, paragraph (4), and shall be placed at intervals not more than 3 m. Cast iron warning plates are supplied by BC Hydro and are included as part of the primary service connection costs.

See BC Hydro ES54 underground civil construction standards for further design details.

### 8.2.1 Third Party Cables

BC Hydro primary supply service cables and third-party communication cables shall be installed in separate ducts, maintaining the minimum separation clearance stipulated by CSA C22.3 No. 7 *Underground systems*.

### 8.2.2 Drainage

The customer shall ensure a downward sloping grade toward drain locations and provide proper drainage of the underground service entrance conduits on their property, including cable pits and pull boxes. BC Hydro will seal the service ducts at the first BC Hydro vault or other structure to help prevent entry of moisture and gases.

Note 31: The customer shall contact their local inspection authority and building department for drainage connection compliance.

### 8.2.3 Primary Service Ducts

The customer shall consult with BC Hydro to determine the number and size of primary service entrance conduits and design details of the ducts to be installed. Proper drainage shall be provided for each duct run.

BC Hydro construction standards are based on installing certified or approved PVC type DB2 ducts, concrete encased, having 3” (75 mm) minimum concrete cover. BC Hydro disapproves of metal conduit as primary service duct but may accept this if mandated by local AHJ.

Ducts shall not pass through ferrous metallic structures in a manner that would induce eddy currents and result in heating of the service cables. The customer shall install 4-inch Hilti CFS-SL GA L Firestop speed sleeves where BC Hydro exposed primary service cables pass through a fire-rated building wall or partition. One sleeve for each cable is required.

The design and construction of underground service ducts shall allow for safe and efficient installation and removal or replacement of primary service cables. The design shall ensure service duct lengths and cable pulling tensions are minimized to reduce the possibility of cable damage from excessive pulling stress, sidewall bearing pressure in bends, and abrasion caused by duct walls. A BC Hydro representative may require the installation of pull boxes at their discretion, particularly if:

a. The service run is longer than 50 metres;

b. Cumulative duct bends exceed 135°;

c. Cable pulling tension exceeds acceptable limits; or

d. Other aspects of the proposed design require special consideration.

BC Hydro personnel use standard pulling equipment and mandrels best suited for the unrestricted conduit diameter. Conduits shall be installed using factory standard bends with a minimum 900 mm radius for 3" (75 mm) and 4" (100 mm) diameter ducts and minimum 1050 mm radius for 5" (125 mm) ducts. Duct end fittings shall be effectively sealed to prevent ingress of sand and other sedimentary materials depositing inside the ducts.

Note 32: BC Hydro does not accept thin-walled electrical metallic tubing conduits for BC Hydro service cables for installation inside a building or parkade.

Customer-installed service ducting shall be proven by having a suitable mandrel pulled through in the presence of a BC Hydro representative. Ducts shall be left with an acceptable new #8 polypropylene pulling string in place. Reused pulling string is not acceptable.

Service ducts shall be finished with an acceptable factory bell end inside pull boxes, pull pits, and kiosk pads.

#### 8.2.3.1 Concrete Encasement

Service ducts specified for concrete encasement shall be certified or approved PVC ducts and shall have concrete-tight couplings and fittings. The ducts shall be enveloped with a minimum concrete covering thickness of 75 mm and shall have a minimum separation, both horizontally and vertically, of 45 mm. The concrete shall be in accordance with the latest revision of CSA concrete standards (A23 series) and have a minimum strength of 20 MPa at 28 days.

If a service duct passes through or enters into a vertical concrete foundation wall, or if differential settlement might impose shear force on a service duct, the customer shall ensure a smooth transition to avoid damage to ducts and service cables. A BC Hydro representative may require the customer to provide an estimate of building structure settlement and required service cable slack. If differential settlement might occur, the customer shall submit an engineered design for concrete encased rebar-reinforced wall entry for service ducts to BC Hydro for acceptance. See BC Hydro standard ES54 S0-05-*General Notes Service Ducts and Trenches*

#### 8.2.3.2 Structural Supports

Concrete encased PVC ducts inside a building shall be designed and constructed to support the weight of the concrete, ducts, and service cables, and to withstand all cable pulling forces (provided by a BC Hydro representative) during the installation and removal of service cables. Duct support structures shall be engineered.

## 8.3 Indoor Primary Service Vaults

All aspects of an electrical equipment vault, including but not limited to doors, ventilation, and drainage, shall be constructed in accordance with applicable BC Building Code requirements and local bylaws per the AHJ at the site.

### 8.3.1 Vault Location and Access

The vault shall be accessible to BC Hydro personnel via an exterior door located at grade, or vehicle access for a vault located in a parkade having minimum clearance of 2.1m. Indirect access by building freight elevators or other methods is not acceptable to BC Hydro.

The vault for slab-on-grade buildings shall be located at the side or adjacent to the BC Hydro underground supply point. See BC Hydro standard ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*.

The customer shall locate the primary service vault for parkade-type buildings in agreement with a BC Hydro representative.

The vault location shall provide satisfactory access to allow unobstructed movement for equipment replacement and personnel access. Personnel access doorways shall be minimum 900 mm (3 ft) wide and equipment loading doors shall be minimum 1200 mm (4 ft) wide. A larger doorway may be required depending on equipment size. The vault door shall open outwards.

### 8.3.2 Equipment Layout

The vault shall provide safe working space near the service entrance equipment, including metering provisions, in accordance with BCEC Rule 2-308 *Working space around electrical equipment* and the BC Hydro document *Requirements for Primary Service Voltage Revenue Metering (4 kV to 35 kV)*. BC Hydro requires a minimum 1.5 m clearance in front of the service cable compartment to apply safety grounds in accordance with BC Hydro work procedures. Adequate lighting shall be provided to allow for electrical equipment operation, inspection, and maintenance. Lighting shall be controlled by a wall switch located at the vault entrance.

The primary service vault shall have an unobstructed means of egress in compliance with the BC Building Code. A minimum of 0.6 m clear space shall be maintained from the edge of the access door or components if compartment hinged doors or draw-out components block the exit route when in fully open position.

Note 33: BC Hydro shall not accept a customer primary service vault design with a raised staircase from the vault floor as the only means of egress or emergency exit.

Passageways and working spaces around electrical equipment shall not be used for storage. They shall be kept clear of obstructions and arranged to give BC Hydro ready access to the service entrance and metering compartments.

### 8.3.3 Cable Pull Pit

BC Hydro requires construction of cable pull pits for indoor vaults. Service entrance conduits shall terminate in a cable pull pit under the primary service switchgear cubicle unless otherwise advised by BC Hydro.

The pit shall have sufficient dimensions to accommodate a minimum 900 mm radius bend or as advised by a BC Hydro representative, to train the supply service cables into their compartment. The minimum length of the pull pit shall be 2100 mm from primary duct entrance wall to the opposing wall to accommodate cable pulling.

Cable pits shall extend outside the primary service switchgear to permit easy supply service cable installation. See BC Hydro standard ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property*

*Installation* for detailed requirements. Cable pits shall be covered by suitable aluminum checker plates as shown in ES54 S3-03. Cover plates shall be sized and located for easy removal, taking into account weight restrictions for handling by a single worker (18 kg maximum for a removable section and 36 kg maximum for a hinged section, pursuant to BC Hydro work procedures).The minimum angle for hinged covers shall not be less than 135°. Each plate located outside a restricted cable vault shall be bolted down for safety and shall restrict access to unauthorized persons by use of BC Hydro proprietary puzzle bolts. Standard machine bolts are acceptable for vaults with access restricted to qualified personnel. A pull pit shall have minimum clear access measuring 900 mm x 700 mm with the plates removed, and shall not be considered a confined space. A BC Hydro representative shall review and accept customer submissions for cable pull pit and checker plate covers prior to construction, fabrication, and installation.

A solid concrete barrier is required through the full length of the pit if both BC Hydro and customer cables are located in the same cable pit, to provide complete physical separation.

A site meeting between a BC Hydro civil inspector and the electrical contractor is required to finalize the cable pit cover layout and details before manufacturing can begin.

The cable pit for services with future expansion requirements shall be sufficiently large with suitably placed pulling eyes and removable checker plate covers to enable the cables to be pulled and trained to enter existing and future switchgear locations without difficulty. The customer shall provide an adequate number of conduits to allow for future expansion, in consultation with BC Hydro.

Proper cable pit drainage shall be provided per 8.2.2 Drainage.

### 8.3.4 Indoor Pull Boxes

A metal pull box meeting the following requirements may be used for indoor pull box installations subject to acceptance by a BC Hydro representative per BC Hydro standard ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*:

a. Minimum 900 mm wide x 1800 mm high x 300 mm deep for top or bottom entry;

b. Minimum 900 mm wide x 1800 mm high x 750 mm deep for back entry. Pull box depth shall allow the minimum bending radius of BC Hydro service cables, which varies from 255 mm to 725 mm depending on cable size and design;

c. 1⅝" x”1⅝" C-channels to accept BC Hydro-supplied cable support and restraint hardware. Cable shall be supported at least every 1 m;

d. Pulling irons as shown in BC Hydro standard ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*;

e. A hinged cover door;

f. Shrouded penta bolts for installations outside the primary service vault; and

g. A padlock hasp and staple sub-assembly suitable for a BC Hydro padlock only. See 8.1.1.4 Padlocks for padlock specifications.

### 8.3.5 Remote Shunt Trip

The customer shall have a remote shunt trip operated by a maintained contact pushbutton located inside the building main entrance as required by local fire marshal to facilitate emergency disconnection of customer primary service. The pushbutton shall be ¼-turn reset installed inside a tamperproof box next to the main fire alarm panel or as directed by fire marshal. See 3.12 Fire Protection for shunt trip requirements.

A jointly operated customer primary service switch that is oil-filled or gas-filled shall have a remote shunt-trip pushbutton installed inside a tamperproof box hardwired to the service main trip coil to immediately trip the service. The pushbutton shall be located outside the service vault at a readily accessible location and shall be

equipped with a staple and hasp for the installation of a BC Hydro padlock See 8.1.1.4 Padlocks for padlock specifications.

The shunt trip pushbutton shall have a dry-type contact hard-wired into the contactor/breaker trip coil and hard-wired interlock to prevent operation of the contactor/breaker close coil until the trip pushbutton is reset.

The remote shunt trip shall be supplied, installed, and connected by the customer.

### 8.3.6 Height

Vault height shall be minimum 2.2 m. The vault size and clearances shall meet the requirements of TSBC, BCEC, BC Building Code, and any other applicable requirements per local AHJs.

## 8.4 Outdoor Primary Service Kiosks

BC Hydro continues to work with equipment suppliers to install dead-front equipment for outdoor customer-owned primary service equipment for improved safety and reliability. See 9.1.9 Dead-Front Switchgear for a list of acceptable equipment suppliers.

BC Hydro no longer accepts concrete cable pull pits located below an outdoor primary service kiosk. Kiosks shall be installed in accordance with BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation* or ES54 S3-02 *Primary Services Live-Front Outdoor Kiosk Private Property Installation* as applicable. A cable pull box shall be located per 8.4.1 Outdoor Pull Boxes, allowing adequate sealing of the service conduits and preventing ingress of earth gases into the service kiosk, which reduces component deterioration and extends the life expectancy of the service kiosk. Contact a BC Hydro representative for more information.

Outdoor service kiosks shall be an approved assembly that bears evidence of either a mark or label of a certification agency accredited by the Standards Council of Canada, or an approval label issued by TSBC or other accredited organization under section 10 of the *Safety Standards Act* such as the SPE1000 model code field approval, and installed on a customer-owned flat concrete pad with a cable duct window below a utility supply service cable compartment.

### 8.4.1 Outdoor Pull Boxes

BC Hydro may require installation of a concrete pull box equivalent to either a BC Hydro standard 832 box or 1232 box.

Note 34: Cable vaults (manholes) are not typically allowed as part of the customer's service as their classification as a confined space has operational impacts. While use of cable vaults is discouraged, special circumstances or conditions should be reviewed with a BC Hydro representative. Use of cable vaults is treated as a variance and will be evaluated at BC Hydro's sole discretion.

An 832 pull box with one riser shall be installed for 4/0 AWG (or smaller) supply service cables. A 1232 pull box with two risers (to accommodate a larger service cable bending radius) shall be installed for 500 kcmil and 750 kcmil sized supply service cables.

The pull box shall be located approximately 6.0 m from the outdoor primary service kiosk. Greater separation may be acceptable with the approval of the BC Hydro field manager. 832 and 1232 boxes shall be installed to accept a proprietary BC Hydro security bolt.

## 8.5 Equipment Identification and Safety Decals

BC Hydro will apply equipment identification and safety decals to the supply authority-related portions of customer-owned equipment to support the safe and reliable operation of the BC Hydro distribution system.

The customer's installation shall allocate adequate space for the necessary decals in a prominent manner per the requirements of this section. Clutter caused by placement of other non-critical unregulated decals and signs shall be minimized.

Allocated application surfaces shall be vertical and located away from areas subjected to regular mechanical abrasion (e.g. near door handles), exposure to deleterious substances, and other factors that could significantly reduce decal service life and performance.

Decals shall be supplied and installed by BC Hydro. See Appendix 2 Reference Documents for decal examples.

## 8.5.1 Indoor Primary Service Vaults

BC Hydro will apply decals to indoor installations on the outside of the:

a. Electrical service vault doors;

b. Supply service cable compartment door; and

c. Service switch compartment door, where applicable.

### 8.5.1.1 Electrical Service Vault Doors

**Table 8-1** – Decals applied to outside of indoor electrical service vault door

| Decal | Dimensions (w x h) | BC Hydro material number |
|---|---|---|
| Danger Keep Out | 145 mm x 270 mm | 9700-4268 |
| Building Electrical Service | 450 mm x 100 mm | 9700-3120 |
| Notice: No Storage Allowed | 280 mm x 215 mm | 9700-3719 |
| Vault identification number | 530 mm x 125 mm | various |

### 8.5.1.2 Supply Service Cable Compartment Door

**Table 8-2** – Decals applied to outside of indoor supply service cable compartment door

| Decal | Dimensions (w x h) | BC Hydro material number |
|---|---|---|
| Danger Keep Out | 145 mm x 270 mm | 9700-4268 |
| Circuit ID number | 500 mm x 102 mm | various |

### 8.5.1.3 Service Switch Compartment Door

Table 8-3 lists the decals applied to the outside of a service switch compartment door. If there is no compartment door, as is allowed for switches with shared operating authority, other means of marking the information (e.g. BC Hydro standard slide-in modular marking system, industrial label maker) will be used.

**Table 8-3** – Decals applied to outside of indoor service switch compartment door

| Decal | Dimensions (w x h) | BC Hydro material number |
|---|---|---|
| Danger Keep Out | 145 mm x 270 mm | 9700-4268 |
| Alphanumeric ID decals | 530 mm x 125 mm | various |

## 8.5.2 Outdoor Primary Service Kiosks

BC Hydro will apply decals to outdoor installations on the outside of the:

a. Supply service cable compartment door; and

b. Service switch compartment door.

#### 8.5.2.1 Service Supply Service Cable Compartment Door

**Table 8-4** – Decals applied to outside of outdoor supply service cable compartment door

| Decal | Dimensions (w x h) | BC Hydro material number |
|---|---|---|
| Danger Keep Out | 145 mm x 270 mm | 9700-4268 |
| Circuit ID number | 500 mm x 102 mm | various |

#### 8.5.2.2 Service Switch Compartment Door

**Table 8-5** – Decals applied to outside of outdoor service switch compartment door

| Decal | Dimensions (w x h) | BC Hydro material number |
|---|---|---|
| Danger Keep Out | 145 mm x 270 mm | 9700-4268 |
| Alphanumeric ID decals | 530 mm x 125 mm | various |

# 9 Primary Service Switchboard Construction

## 9.1 General

Construction of the primary service switchboard shall comply with CSA C22.2 No. 31 *Switchgear assemblies* and bear evidence of either a mark or label of a certification agency accredited by the Standards Council of Canada, or an approval label issued by TSBC or other accredited organization under section 10 of the *Safety Standards Act* such as the SPE1000 model code field approval.

Note 35: The incoming switchboard compartment shall be designated as the customer service box and shall contain service fuses, a service switch or breaker, and associated relaying and power monitoring devices. Customer branch feeders and apparatus not related to the primary service supply shall not be installed inside the incoming customer primary switch compartment.

Switchboard compartments shall be constructed for easy supply authority access to components when required. Access to service cable terminations, loadbreak switches, disconnects (where required), and metering compartments shall be through single hinged door panels securely fastened by bolting and locking (where applicable).

A separate heater power supply shall be provided downstream of the metering supply point where heaters are required to maintain temperature and control moisture inside switchboard compartments. Heaters shall be controlled by a humidistat and rated for 120 V minimum. See 7.5 Customer Scope of Supply for Outdoor Primary Service Kiosks for other requirements related to auxiliary equipment.

Main protection relays used on overhead and underground incoming supply may receive power downstream of the metering supply point.

Note 36: Spare fuses should be supplied and stored in a separate wall mounted cabinet accessible to operating personnel to minimize customer outage time caused by fuse operation. It is unacceptable to mount the spare fuses inside the switchgear fuse compartment if access to the spare fuses requires a power outage. The customer's licensed electrician is responsible for re-fusing customer equipment. This will not be performed by BC Hydro.

Paint the inside surfaces of compartments with viewing windows a light colour to aid visual inspection of switch and breaker status.

Door panels are access restricted to BC Hydro (supply authority), the customer, or jointly (BC Hydro and customer). BC Hydro restricted access door panels shall have only one locking point, a compatible hasp and staple subassembly, without any secondary lockable points such as lockable handle or shrouded penta bolt with padlock provision. Joint access door panels shall have two locking points, facilitated by a dual hasp and staple subassembly. No other locking points (e.g. lockable handle, shrouded penta bolt with padlock provision) are permitted.

### 9.1.1 Supply Service Cable Compartment

The supply service cable compartment shall be restricted to BC Hydro access only and reserved solely for mounting service cable terminations. The supply service cable compartment shall remain free of junction boxes, terminal blocks, surge arresters, and other ancillary devices. It shall not contain conductors not directly related to the equipment located in the supply service cable compartment (e.g. no gradient control conductors, control cables, secondary conductors).

BC Hydro requires a 3" x ¼" (76.2 mm x 6.4 mm) copper bus for terminating the neutral conductor, metallic cable shield(s), or concentric neutral conductors. See the BC Hydro ES54 S3 primary services standards for drilling patterns and spacing. 50 mm minimum clearance from compartment panels is required to provide clearance for field installation of threaded fasteners.

The service buses/bushings shall have a phasing arrangement of A-B-C, left to right.

### 9.1.2 Interlocks

Interlocks shall be provided between the service loadbreak switches, disconnect switches, and primary metering compartments (padlocks not acceptable) in accordance with CSA C22.2 No. 31 *Switchgear assemblies*.

See BC Hydro drawing PG A2-02 *Dual Supply Service Four Key Interlock* in Appendix 1 List of Primary Guide Standards for typical interlocking details for dual supply.

### 9.1.3 Dual Radial Primary Services

The service switchgear arrangement for existing dual radial primary services permits manual momentary paralleling of the two BC Hydro circuits during load transfer. Manual momentary paralleling of either of the two normal BC Hydro circuits and the standby circuit during load transfer is permissible for existing double dual radial services. Such operations shall only be performed by BC Hydro personnel. There are exceptions for customers to operate these switches under a special agreement with BC Hydro. See 9.3 Service Entrance Compartment Dual Radial Supply (Legacy Reference) and 9.4 Service Entrance Compartment Dual Supply.

#### 9.1.3.1 Bolted Bus Bar Sections

Existing dual radial configurations where sections of bus are required to be bolted and removable for equipment maintenance purposes should have a sheet metal barrier available for insertion in the gap when bus sections are removed to help minimize customer outage time. The metal barrier shall be a slide-type and be suitably stored (fastened) in the loadbreak switch compartment when not in use. CSA standard phase-to-ground clearance shall be observed between the bus or component ends and the inserted metal barrier.

### 9.1.4 Outdoor Primary Service Kiosk Specific Requirements

BC Hydro requires the following for outdoor primary service kiosks:

a. “Shoebox” type door panels with neoprene gaskets; and

b. The external cover door shall be equipped with a padlocking hasp and staple subassembly compatible with a BC Hydro padlock. Penta bolts with welded pipe shrouds 34 mm in diameter (1 5/16") and 40 mm long (1 9/16") shall be included as required to secure each compartment.

### 9.1.5 Indoor Primary Service Specific Requirements

Access to indoor primary service vaults is restricted to qualified personnel. The utility service supply cable compartment door requires a 3-point latch and hasp for a BC Hydro padlock. Penta bolts and tamperproof shrouds are not required for indoor installations. No door is required on switchgear compartments with shared operating authority.

### 9.1.6 Sulphur Hexafluoride ($SF_6$) Filled Equipment

BC Hydro accepts $SF_6$-insulated customer-owned primary service switchgear for indoor and outdoor installations for improved safety, reliability, and reduced cost of ownership. The switch and enclosure shall conform to the following requirements:

a. A certified test report including the initial volume of $SF_6$ gas, expected leakage rates, and proof of load make-and-break capabilities at expected end-of-life gas volume;

b. Switches with an integral filling port shall be equipped with a pressure indicating device for low $SF_6$ gas pressure and a warning sign placed on the equipment;

c. The service switch shall be equipped with integral viewing ports;

d. An integral grounding switch for each pole, mechanically interlocked to prevent direct switching from grounded to closed position; and

e. Screened and louvered ventilation ports on the front and back baseboards as a means of egress for leaking $SF_6$ gas, minimum 1 $cm^2$ port per 1 litre volume of $SF_6$ gas contained inside the switch.

#### 9.1.6.1 Viewing Window

$SF_6$-insulated primary service switches shall incorporate integrated viewing ports to allow for visual inspection of the switch contacts, with moving and stationary contacts clearly visible, similar to BC Hydro standard dead-front switchgear. The viewing ports shall meet the requirements of applicable CSA, BCEC, and TSBC or the *Safety Standards Act*, as appropriate, and carry a certification mark of approval. Viewing ports shall be accessible from ground level without the use of a ladder and shall be acceptable to BC Hydro.

Viewing ports shall be supplied complete with a self-closing arc flash cover and warning sign.

### 9.1.7 Additional Safety Requirements for Service Cable Compartments

A ball stud shall be permanently mounted on each phase bus bar (for live-front switchgear) and on the equipment ground bus in a supply service cable compartment, as required by WorkSafeBC and BC Hydro work procedures for installation of personal protective grounding. Ball studs shall be positioned to accept universal grounding ball clamps operated with hot sticks.

BC Hydro requires the extension of a ground bus and seven grounding ball studs in a primary revenue metering cubicle. There shall be one grounding ball stud on either each side of three current transformers and one grounding ball stud bolted to the ground bus (see BC Hydro revenue metering requirements on the BC Hydro website).

BC Hydro has recorded numerous safety failure incidents of cast and drop-forged grounding ball studs when installing safety grounds. These incidents have led BC Hydro to phase out cast and drop-forged ball studs and to only accept machined ball studs for new installations.Table 9-1 shows the grounding ball studs that BC Hydro accepts.

**Table 9-1** – Acceptable ground ball studs

| Manufacturer | Part number |
|---|---|
| MacLean Power Systems | HC 30029-1 |
| MacLean Power Systems | HC 30029-2 |
| MacLean Power Systems | HC 30029-3.5 |
| Prime Engineering | GBS-01 Assembly_4.0 |
| Prime Engineering | GBS-07 Assembly_4.1 |

### 9.1.8 Live-Front Switchgear

BC Hydro personnel require safe access to a customer-owned supply service cable compartment and instrument transformer compartment. BC Hydro personnel shall be able to complete a visual inspection of the primary service visible disconnection point (e.g. isolation switch open and switch blades pulled down from the line contacts above). BC Hydro accepts draw-out switchgear for customer-owned primary services with oil-filled or vacuum circuit breakers or switches as the disconnecting device. Alternatively, these disconnecting devices may be preceded with an air-insulated disconnect switch as an acceptable safety barrier and visible disconnection point.

Note 37: Open contacts inside an oil-filled circuit breaker or vacuum bottle are not an acceptable isolation point for safe access to a supply service cable compartment or instrument transformer compartment.

Exposed cable connections and buswork inside the primary service cable compartment shall be covered with removable insulation barriers to prevent accidental contact with energized live parts per WorkSafeBC requirements, BC Hydro work procedures, and regulations governing the limits of approach. The buswork may be covered with rated polymer-based material, while cable connections and grounding balls may be covered with adequately rated removable insulation boots. See BC Hydro standards ES54 S3-02 *Primary Services Live-Front Outdoor Kiosk Private Property Installation* and ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*, and Figure A3-1 *BC Hydro utility service cable compartment* in Appendix 3 Photographs for design and installation details.

See BC Hydro's *Safety Practice Regulations, Rule 401 Limits of Approach* for more information.

#### 9.1.8.1 Viewing Window

Viewing windows are required for safety reasons to enable BC Hydro personnel to determine the status of switches and circuit breakers (see 'Visible disconnection point' in 2 Definitions). The windows shall be wired glass or heat-tempered plate glass, and shall be sized and positioned so a viewer can conveniently observe switch blade status with the access door closed. A viewing window for an indoor type air-rated switch shall have minimum dimensions of 250 mm x 380 mm. Viewing windows shall be accessible from ground level without the use of a ladder and shall be acceptable to BC Hydro. The use of cameras is not acceptable.

Viewing windows shall be supplied complete with a self-closing arc flash cover and warning sign.

#### 9.1.8.2 Operating Handle

The height of the operating handle pivot point for loadbreak switches operated by BC Hydro personnel shall be 1.5 m or less above the vault floor.

A guard shall be provided if a chain is used between an operating handle and a loadbreak or disconnect switch so that if the chain breaks it will not contact any live parts.

### 9.1.9 Dead-Front Switchgear

See BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation* and ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation,* and photographs in Appendix 3 Photographs.

BC Hydro continues to improve the safety of primary service connections through field evaluation and acceptance of dead-front switchgear designs for customer-owned primary services. Due to the design of dead-front switchgear there is no access to the high-voltage conductors, so the service bushings shall be grounded via the customer's loadbreak grounding switch to comply with BC Hydro work procedures and *Safety Practice Regulations*. BC Hydro assumes operating authority over a shared or dedicated switch (depending on equipment design) to facilitate this requirement.

Table 9-2 shows acceptable customer-owned dead-front primary service equipment for indoor and outdoor applications. Though this equipment has been evaluated and field-validated by BC Hydro to be acceptable for use, each specific application shall be accepted by a BC Hydro representative.

**Table 9-2** – Acceptable customer-owned dead-front primary service equipment

| Manufacturer | Equipment configuration | Acceptable for indoor applications | Acceptable for outdoor kiosk applications |
|---|---|---|---|
| Eaton / Cooper Power Series / Cooper Power Systems | Fluid-insulated shared loadbreak grounding switch mechanically interlocked with relay-controlled vacuum fault interrupter | Yes | Yes |

| Manufacturer | Equipment configuration | Acceptable for indoor applications | Acceptable for outdoor kiosk applications |
|---|---|---|---|
| Power Systems Technology (PST) | MiniSub $SF_6$-insulated switchgear with shared loadbreak grounding switch and relay-controlled vacuum fault interrupter | Yes | Equipment under evaluation |
| S&C Electric Co. | Vista model 211 $SF_6$-insulated switchgear with dedicated supply authority loadbreak grounding switch and dedicated customer interrupter | Yes | Yes |

See Appendix 3 Photographs for photographs of typical equipment application. Dead-front equipment is consistent with BC Hydro work methods and provides an additional safety barrier. BC Hydro Distribution Standards continues to work with manufacturers toward BC Hydro acceptance of additional dead-front equipment designs.

Following is a list of specific requirements for dead-front customer-owned primary service equipment. All other relevant requirements of this Primary Guide also apply. This list may not be definitive. Requirements are applied in conjunction with a comprehensive evaluation process conducted by BC Hydro:

a. Equipment assembly shall bear evidence of either a mark or label of a certification agency accredited by the Standards Council of Canada, or an approval label issued by TSBC or other accredited organization under section 10 of the *Safety Standards Act* such as the SPE1000 model code field approval;

b. Indoor service switchgear shall comply with the BCEC for installation of fluid-filled equipment or $SF_6$-insulated equipment, as appropriate;

c. Dead-front primary service equipment shall be equipped with viewing ports, meeting the requirements of 9.1.9.1 Viewing Window;

d. Equipment shall be in three-phase configuration;

e. The supply service cable compartment shall have access restricted to BC Hydro personnel only with a metal barrier to partition it from other areas of the switchboard. Removal of the threaded fasteners securing the barrier shall require access to the supply service cable compartment;

f. Access provisions for the supply service cable compartment and switch compartment may incorporate bolted removable panels in addition to a padlocked hinged door as a single assembly. The access door and panel assembly need not be full height (i.e. 80″);

g. The switch compartment for outdoor switchgear installations requiring shared operating authority between BC Hydro and the customer shall be equipped with a double hasp and staple subassembly for installing BC Hydro and customer locks independently;

h. The service switch shall have an integral ground position configured to allow service bushing grounding. The switch shall be lockable in the ground position using a BC Hydro padlock. It shall be possible to block the switch from being placed in the grounding position with a BC Hydro padlock;

i. The service switch shall allow locking in the open position using a BC Hydro padlock;

j. The service bushings shall be 900 A deadbreak interface (copper contact), 25 kV class, and meet the requirements of IEEE 386 *Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV*;

k. A capacitive-type voltage indicator shall be installed between each service bushing and the service switch as a live line indicator at the service bushing;

l. A key interlock for revenue metering compartment access for switchgear with separate customer and supply authority switches (i.e. S&C Electric Vista) shall be installed on the customer's switch only;

m. Switchboard design shall meet the requirements of BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation* or ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation* as applicable;

n. Compartment doors and panels shall be large enough and unencumbered by manufacturer and customer markings to accommodate BC Hydro equipment marking decals; and

o. Relaying transformers may be connected to the line side and 18 kV rated surge arrestors on the load side of the mechanically interlocked service switch and interrupter assembly.

#### 9.1.9.1 Viewing Window

Switches shall incorporate integrated viewing ports to allow for visual inspection of the switch contacts, with moving and stationary contacts clearly visible, similar to BC Hydro standard dead-front switchgear. Viewing ports shall meet the requirements of applicable CSA, BCEC, and TSBC or the *Safety Standards Act*, as appropriate and carry a certification mark of approval. Viewing ports shall be accessible from ground level without the use of a ladder and shall be acceptable to BC Hydro. The use of cameras is not acceptable.

Viewing ports shall be supplied complete with a non-removable self-closing arc flash cover and warning sign, unless the switch is internally mechanically interlocked with a downstream protective device so it cannot be operated under load.

### 9.1.10 Unacceptable Equipment

BC Hydro will neither accept nor operate customer-owned loadbreak elbow cable terminators.

Primary service kiosk designs with an integral oil-immersed loadbreak switch housed in a separate compartment attached to the transformer tank as a primary service switch do not comply with BC Hydro work methods or with this Primary Guide.

Note 38: A limited number of customer-owned primary service kiosks with loadbreak elbows and oil-immersed service switches were installed in the past under special local operating order provisions. These types of installations are no longer acceptable to BC Hydro.

## 9.2 Service Entrance Compartment Single Radial Supply

Separate compartments are required for service cable terminations and the customer's loadbreak switch in the service entrance compartment for single radial supply service:

a. Loadbreak switches and fuses shall be installed in separate compartments;

b. Proper termination space and cable supports shall be provided as detailed in BC Hydro standards ES54 S3-01 *Primary Services Dead-Front Outdoor Kiosk Private Property Installation*, ES54 S3-02 *Primary Services Live-Front Outdoor Kiosk Private Property Installation*, and ES54 S3-03 *Primary Services Live-Front Indoor Switchgear Private Property Installation*. BC Hydro height requirements can be met by using base spacers separated to match each enclosure to increase the cable termination height; and

c. Key interlocks shall be provided between the loadbreak switches and fuses so the fuse compartment cannot be opened unless the loadbreak switches are locked open.

See drawing PG A1-01 *One Line Diagram Single Radial Supply Typical for U/G Supply Service* in Appendix 1 List of Primary Guide Standards.

Note 39: BC Hydro personnel rely on a class A electrician working for the customer to operate customer-owned equipment for single radial supply. BC Hydro will not operate customer live-front equipment.

BC Hydro may operate customer dead-front equipment from closed to open, open to ground, and ground to open when required to support BC Hydro's work. The customer's electrician is responsible for closing the switch and restoring service to the customer's facility. Viewing window and switch operating handle locations shall meet applicable CSA standards and requirements of the local inspection and regulating authorities.

## 9.3 Service Entrance Compartment Dual Radial Supply (Legacy Reference)

Existing dual radial service entrance equipment shall have an arrangement and layout that allows safe servicing and replacing of the following service entrance switchgear components with minimum interruption of service:

a. Service cable termination;

b. Service disconnect switch; and

c. Service loadbreak switch or breaker.

This shall be made possible by the operation of switches and mechanical removal of bolted bus bar sections. A brief outage will be required to allow safe isolation of the components for servicing.

For existing dual radial supply switchboards:

a. Cable terminations, disconnect switches, loadbreak switches, and the fuse/circuit breaker shall be installed in separate compartments connected by bus bar sections (removable bus links as required);

b. Viewing windows shall be provided;

c. Provision shall be made for padlocking the loadbreak and disconnect switches with BC Hydro standard padlocks when the switches are in the open position; and

d. Dual supply switches, forming a part of the customer-owned switchgear, shall be equipped with acceptable locking provisions for restricted access and operation by BC Hydro personnel only.

Note 40: Dual radial supply customer-owned switches and associated equipment shall be maintained by the customer in accordance with regular maintenance notices issued to the customer by BC Hydro. See BC Hydro standard ES 64-C-03.06 *BC Hydro Distribution Inspection* and *Maintenance Standard Dual Radial Vault Inspection/Maintenance Certification* in Appendix 2 Reference Documents.

## 9.4 Service Entrance Compartment Dual Supply

Dual supply service entrance equipment shall meet the requirements of 9.3 Service Entrance Compartment Dual Radial Supply (Legacy Reference). See drawing PG A2-02 *Dual Supply Service Four Key Interlock* in Appendix 1 List of Primary Guide Standards and BC Hydro standard ES54 E6-02 *BC Hydro Switchgear Vault in Customer-Owned Building Dual Supply* which show a typical layout and configuration of primary service connections and BC Hydro requirements.

Provision shall be made for padlocking the loadbreak and disconnect switches and tie switch with BC Hydro standard padlocks when the switches are in the open position.

# 10 Primary Service Protection Requirements

## 10.1 Equipment Rating

### 10.1.1 Current

Equipment shall be rated in accordance with applicable CSA standards.

### 10.1.2 Voltage

Equipment shall be rated to BC Hydro's system voltage.

Note 41: If service entrance equipment is installed in an area scheduled for future voltage conversion to 25 kV, provisions shall be made for the equipment to operate at 25 kV with minimal modifications. Equipment for 25 kV conversion not in use at 12 kV shall be stored in a clearly labelled and accessible compartment.

### 10.1.3 Basic Impulse Level

The minimum basic impulse level rating requirement for customer-owned equipment is:

a. 60 kV on the 4.16 kV system;

b. 60 kV on the 7.2 kV system;

c. 95 kV on the 12.5 kV system;

d. 110 kV on the 14.4 kV system;

e. 125 kV on the 25 kV system; and

f. 150 kV on the 34.5 kV system.

### 10.1.4 Interrupting Rating and Minimum Time Margins

Table 10-1 shows the minimum fault interrupting rating, fault closing, and withstand and short circuit bracing requirement for the customer's service main.

**Table 10-1** – Interrupting rating and fault closing

| Type of service | Interrupting rating | | |
|---|---|---|---|
| | Circuit breakers / reclosers (MVA) | Fuses and fuse links | |
| | | Asymmetric root-mean-square (Amps) | Symmetric root-mean-square (Amps) |
| 4.16 kV, 3Ø 4-wire | 50 | 12,000 | 7,500 |
| 12.5 kV, 3Ø 4-wire | 250 | 20,000 | 11,500 |
| 25 kV, 3Ø 4-wire | 500 | 20,000 | 11,500 |
| 34.5 kV, 3Ø 4-wire | 300 | 9,000 | 5,000 |

The customer shall coordinate their primary service overcurrent protection with BC Hydro's upstream protection devices. BC Hydro is responsible for identifying the upstream protection device and communicating protection and fault levels at that location to the customer.

Minimum separation between the customer's service main protection and BC Hydro protection devices will vary depending on the types of protective devices, but shall not be lower than the minimum values defined in

Table 10-2 and accompanying notes. An option for a reduced minimum time margin for customer relay/recloser protection is available if both the customer's response time curve and total clearing time curve are shown on the time-current characteristic graph. The total clearing curve shall include the maximum relay/control response time, breaker/recloser interrupting time, and all other propagation and power-up delays required to clear the fault. Breaker/recloser commissioning test results and protection relay test results including trip times at maximum LG and LLLG faults shall be provided to validate reduced time margin proposals.

**Table 10-2** – Minimum separation of protective devices

| **BC Hydro protection** | **Customer entrance protection minimum time margins** | | |
|---|---|---|---|
| | **Fuse** | **Electromechanical relay** | **Digital relay / digital recloser control** |
| Fuse | Greater of +10% current or +2 cycles time applied to customer fuse maximum clear curve (see note 1) | 18 cycles (0.3 s) (see note 2)<br>or if applicable<br>6 cycles (0.1 s) (see note 4) | 12 cycles (0.2 s) (see note 2)<br>or if applicable<br>3 cycles (0.05 s) (see note 4) |
| Electromechanical relay | 18 cycles (0.3 s) (see note 3) | 18 cycles (0.3 s) (see note 2)<br>or if applicable<br>6 cycles (0.1 s) (see note 4) | 18 cycles (0.3 s) (see note 2)<br>or if applicable<br>6 cycles (0.1 s) (see note 4) |
| Digital relay | 12 cycles (0.2 s) (see note 3) | 18 cycles (0.3 s) (see note 2)<br>or if applicable<br>6 cycles (0.1 s) (see note 4) | 12 cycles (0.2 s) (see note 2)<br>or if applicable<br>3 cycles (0.05 s) (see note 4) |
| Recloser | 12 cycles (0.2 s) (see note 3) | 18 cycles (0.3 s) (see note 2)<br>or if applicable<br>3 cycles (0.05 s) (see note 4) | 12 cycles (0.2 s) (see note 2)<br>or if applicable<br>3 cycles (0.05 s) (see note 4) |

Table 10-2 notes:

1. These additional positive tolerances applied to the customer's maximum clear fuse curve create a coordination curve that must not cross the upstream BC Hydro minimum melt fuse curve up to and including the maximum fault level. For an example see page 1 of drawing *PG D1-01.02 Sample Protection Curves Customer Services and BC Hydro* in Appendix 1 List of Primary Guide Standards. The following remedies may be considered by the customer to achieve acceptable coordination if this time margin cannot be achieved due to high fault current:
   a. Customer can provide instantaneous protection by using a relay/recloser arrangement. The relay/recloser to fuse minimum time margins in Table 10-2 would still apply.
   b. The customer may choose the proper fuse type for fuse-fuse coordination that best coordinates with the current BC Hydro protection device.
   c. BC Hydro protection fuse may be increased provided proper coordination with the upstream protection device can be achieved.
2. Margin between customers relay/recloser response curve and BC Hydro minimum melt fuse curve or BC Hydro relay/recloser response curve.
3. Margin between customers maximum clear fuse curve and BC Hydro relay/recloser response curve.
4. Reduced margin between customers relay/recloser total clearing curve and BC Hydro minimum melt fuse curve or BC Hydro relay/recloser response curve.

## 10.2 Protection with Relays and Circuit Breakers

### 10.2.1 Current Transformers

Current transformers for protection and relaying shall have mechanical and thermal ratings adequate for the expected fault duty.

Current transformers may be located on either side of the circuit breaker provided that they are still located downstream of a customer owned isolation device(e.g. isolation switch, load break switch).

Under no circumstances shall the customer install potential transformers or current tranformers in the cable entrance compartment.

### 10.2.2 Relays

BC Hydro does not require testing and approving of the customer's service entrance protective relays provided they meet minimum requirements specified in IEEE C37.90 *Standard for Surge Withstand Capabilities (SEC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus*. BC Hydro requires the customer to carry out a commissioning test to verify their relays perform as specified, including a primary or secondary injection test (pick-up, reset, and timing) and tripping test. A copy of the relay commissioning report, signed by a professional engineer, shall be submitted to BC Hydro prior to energization, as stated in 5.4 High-Voltage Commissioning Report and Authorization for Connection.

Note 42: BC Hydro may request the customer have protective relay tests for special applications or a particular service failure, performed by an independent test facility (e.g. Powertech Labs Inc.) for acceptance by a BC Hydro accredited representative.

Overcurrent relays may be a single microprocessor based multi-function relay, or, for existing older protection installations, multiple relays arranged as three-phase relays, or as two-phase relays and one ground relay. The microprocessor based relay is preferable and may be required for larger installations for coordination with BC Hydro ground or negative sequence relay elements. The ground relay can be as sensitive as unbalanced loading and inrush will permit.

The minimum separation between characteristics of the customer's relay and the BC Hydro protection system, at the customer's installation at maximum fault current, shall be maintained as described in Table 10-2. Differential relay protection on the customer's main breakers shall be accompanied by overload protection. Differential relay protection alone is not acceptable.

Customer relay protection should be capable of instantaneous phase and ground tripping. If a protection relay response below two cycles can be achieved above an adjustable current pickup threshold, it is accepted as instantaneous. The instantaneous element current pickup threshold should be set at:

a. Not higher than 80% of the BC Hydro instantaneous element current pickup (if existing); and

b. Lower than the fault current for which the coordination time margin described in the Table 10-2 cannot be achieved. BC Hydro may approve, on a per-application basis, simulataneous clearing, between the customer's instantaneous element and BC Hydro's protection system, at high fault levels larger than the customer's instantaneous overcurrent pickup.

It is recommended that customers use separate phase and ground relay curves when the upstream BC Hydro protection device is a relay, recloser, or dead-front switchgear (see page 2 of drawing *PG D1-01.02 Sample Protection Curves Customer Services and BC Hydro* in Appendix 1 List of Primary Guide Standards).

Consideration should be given for load growth within the confines of the service agreement, and cold load pickup when selecting the customer's entrance protection pickup. Total facility loading may be a technical limitation for the customer's entrance protection design under cold load pickup conditions.

Note 43: BC Hydro may request the customer provide an updated authenticated protective relay test report and sealed coordination diagrams for existing installations, or a particular primary service failure, if the most recent report and diagrams are more than five years old.

### 10.2.3 Circuit Breakers

Circuit breakers shall have a maximum interrupting time of five cycles. Circuit breakers may be equipped with an AC trip coil or DC voltage shunt trip coil. If the DC trip is used, the customer is responsible for maintaining its battery supply. If a stored energy voltage trip scheme is applied, such as a capacitor trip, the voltage supply for charging the capacitors may come from the source side of the associated circuit breaker.

A fixed-type circuit breaker (as a service main) shall be equipped and interlocked with a service disconnect switch as shown in drawing PG A1-01 *One Line Diagram Single Radial Supply Typical for U/G Supply Service* (see Appendix 1 List of Primary Guide Standards).

A draw-out circuit breaker (as a service main) equipped with lockout and grounding provisions in a draw-out position is acceptable.

A utility type recloser programmed for single shot operation, approved by the electrical inspection AHJ, is acceptable to BC Hydro as a service main circuit interrupter. See note 24 for this configuration.

## 10.3 Protection with Fuse and Loadbreak Switch

### 10.3.1 Fuse Size

Fuses shall have time-current characteristics that coordinate and provide fully selective clearing with the upstream BC Hydro protective device. The customer shall consult a BC Hydro representative for BC Hydro upstream protective device details for a particular primary service connection during preliminary design (see 5.1.2 BC Hydro Response.

It is not feasible to prepare a table of fuse sizes for each transformer connection. The following general design criteria provide a guide:

a. The fuse shall be sized as small as possible and shall conform with the BCEC;

b. The fuse shall withstand magnetizing inrush current, which varies from 8 to 12 times the rated current of oil-filled transformers for 0.1 to 0.2 seconds. The transformer design greatly affects the magnitude of the inrush current;

c. Short circuit withstand and overload ratings shall exceed the fault currents listed in Table 10-1;

d. The fuse shall coordinate with the BC Hydro upstream protective device with margins at or greater than the minimum times listed in Table 10-2; and

e. Consideration should be given for load growth within the confines of the service agreement, and cold load pickup when selecting the customer's entrance protection pickup. Total facility loading may be a technical limitation for the customer's entrance protection design under cold load pickup conditions.

See drawing PG D1-01.01 *Sample Protection Curves Customer Services and BC Hydro* in Appendix 1 List of Primary Guide Standards for further reference.

Drawing PG D2-01 *Type T Fuse Time-Current Curves* shows BC Hydro's preferred type T fuse curves. The PG D3 drawings show the time-current curves for BC Hydro's typical type E standard speed fuses. See Appendix 1 List of Primary Guide Standards for these drawings.

### 10.3.2 Loadbreak Switch

A customer-owned loadbreak switch installed as a primary service main switch shall have the following minimum current ratings:

a. Load breaking current of 200 A; and

b. Fault closing current withstand of 22 kA lasting 10 cycles.

The use of customer-owned loadbreak switches as a primary circuit opening device for secondary ground fault protection is not acceptable for any type of customer-owned primary service applications.

# Appendix 1 List of Primary Guide Standards

Persons using this manual are responsible for ensuring the following reference documents are the most recent versions.

## Appendix Contents

**A Electrical Schematics**

PG A1-01 One Line Diagram Single Radial Supply Typical for U/G Supply Service

PG A1-02 One Line Diagram Single Radial Supply Typical for O/H Supply Service

PG A2-01 One Line Diagram Dual Supply

PG A2-02 Dual Supply Service Four Key Interlock

**D Protection Coordination**

PG D1-01 Sample Protection Curves Customer Services and BC Hydro (2 sheets)

PG D2-01 Type T Fuse Time-Current Curves

PG D3-01 Type E Fuse Minimum Melting Time-Current Curves All Voltage Ratings

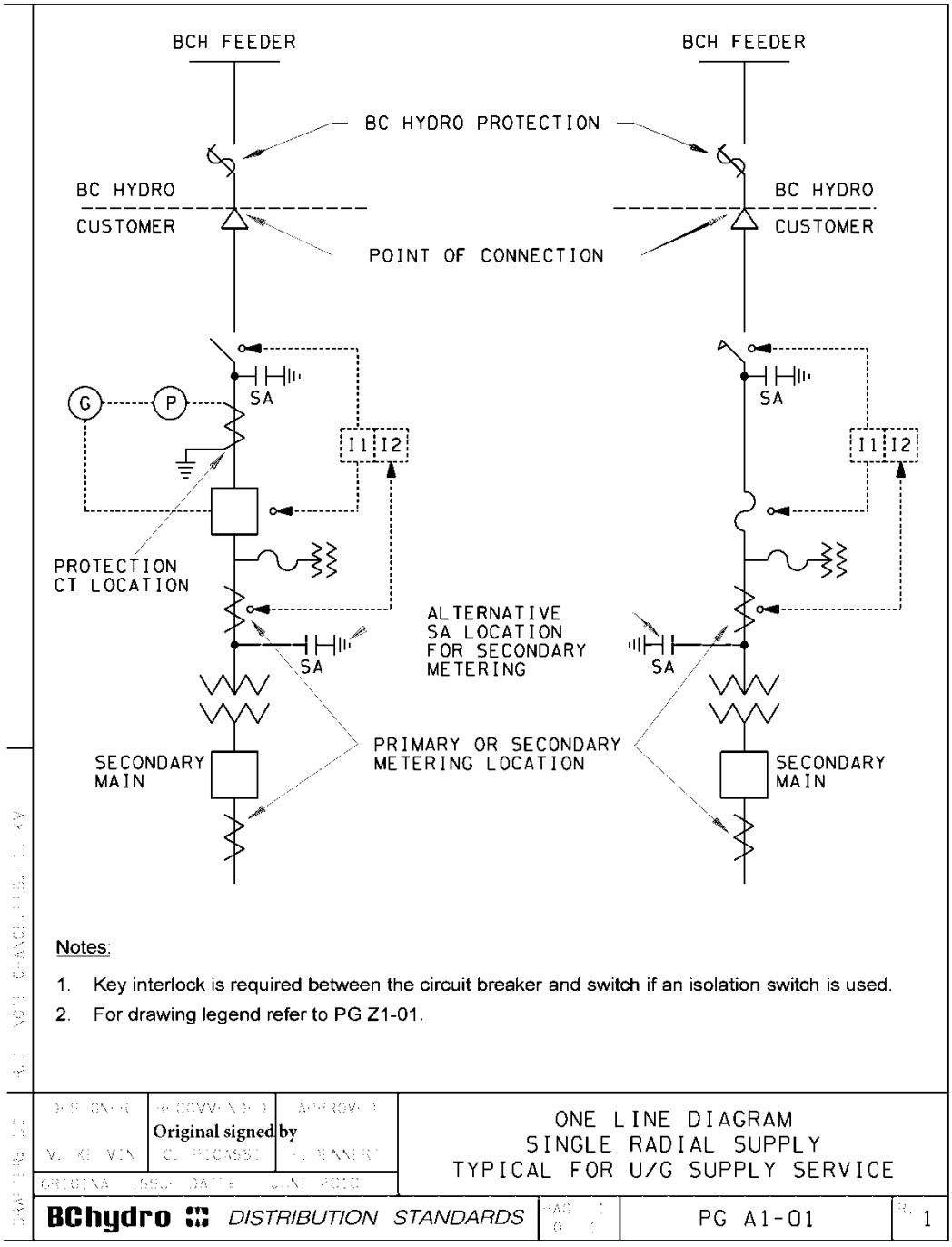
PG D3-02 Type E Fuse Total Clearing Time-Current Curves 4.6 kV and 14.4 kV Ratings

PG D3-03 Type E Fuse Total Clearing Time-Current Curves 25 kV and 34.5 kV Ratings

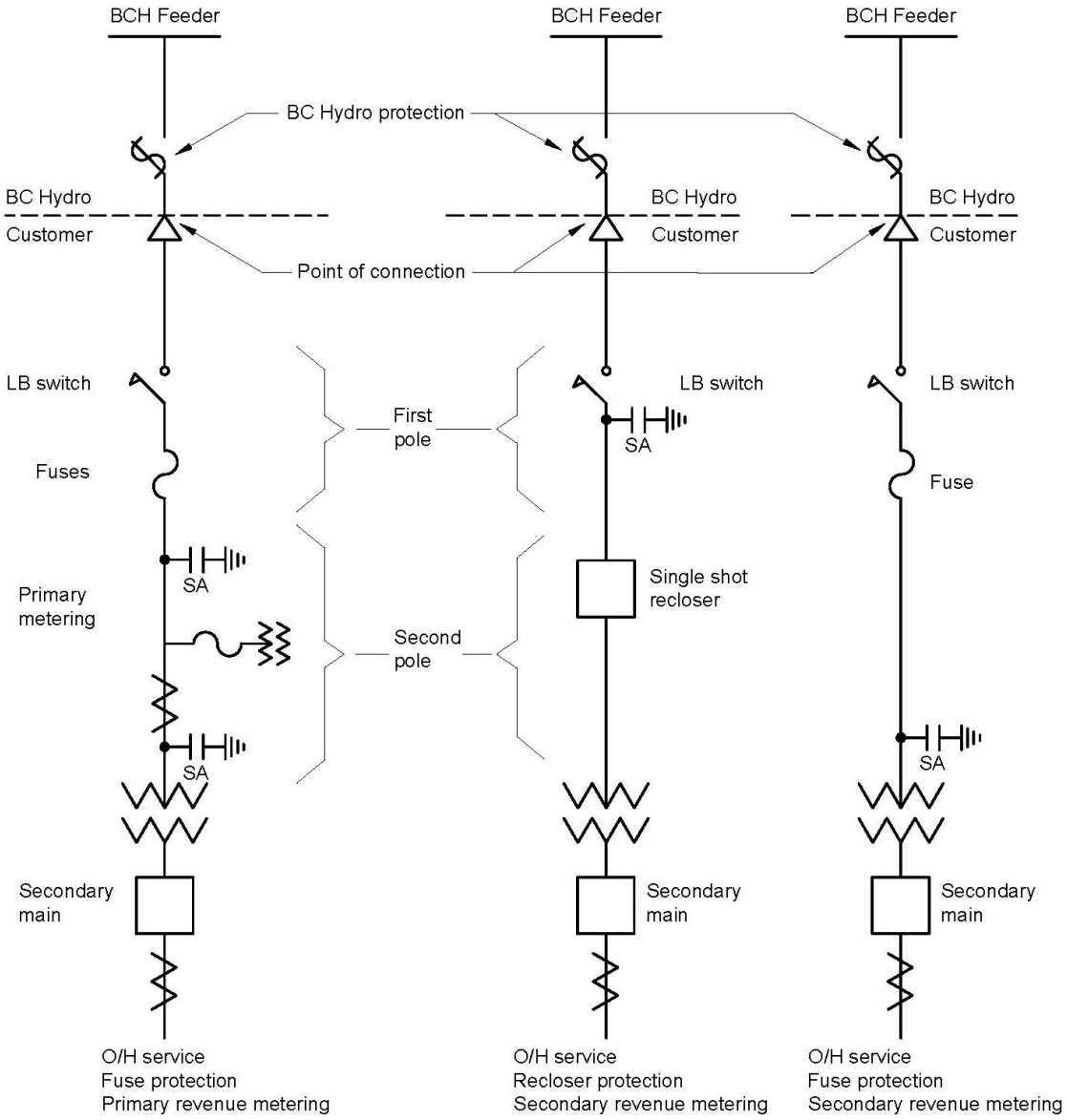
**Z Engineering Data**

PG Z1-01 Primary Voltage Services Drafting Legend

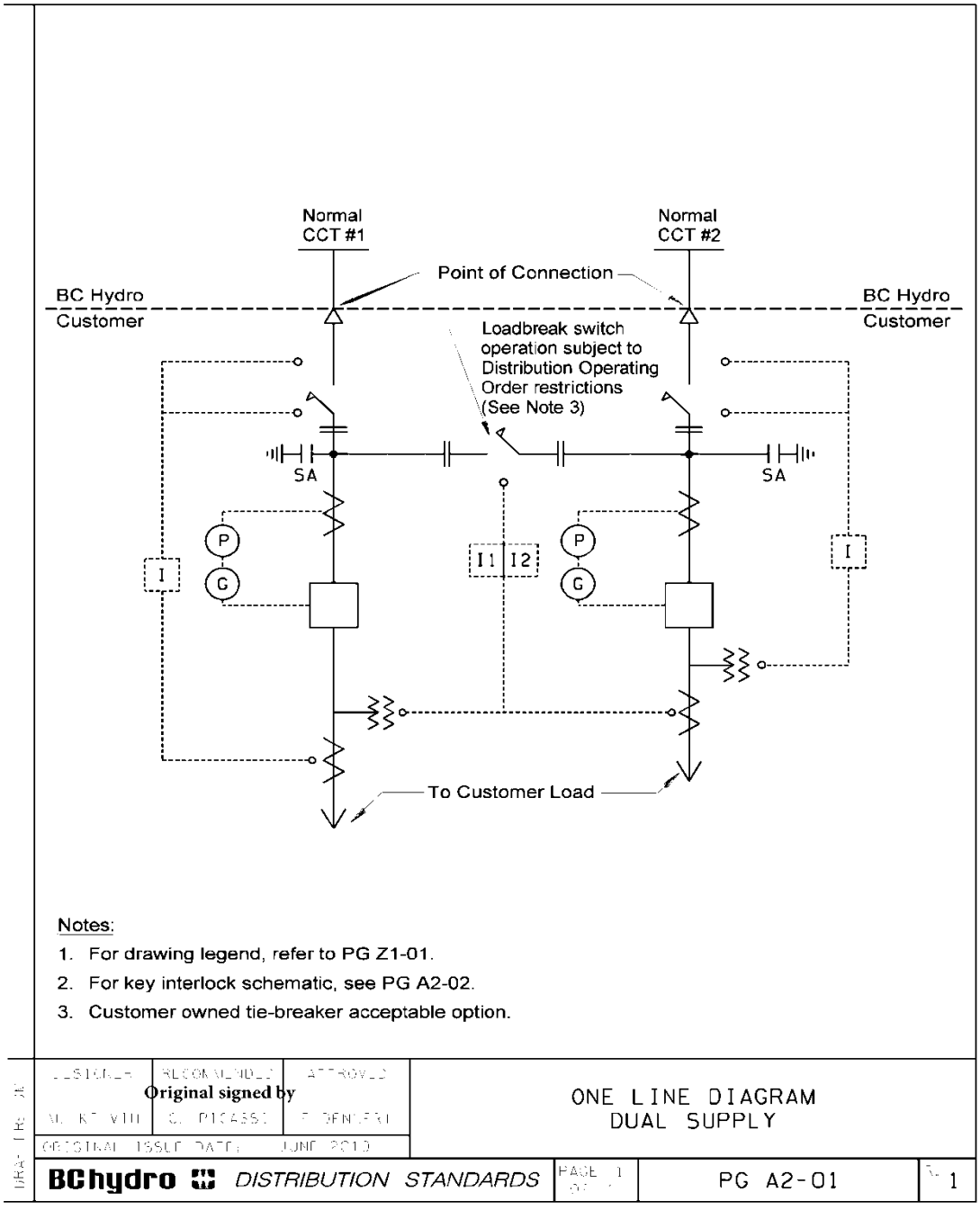
## A Electrical Schematics



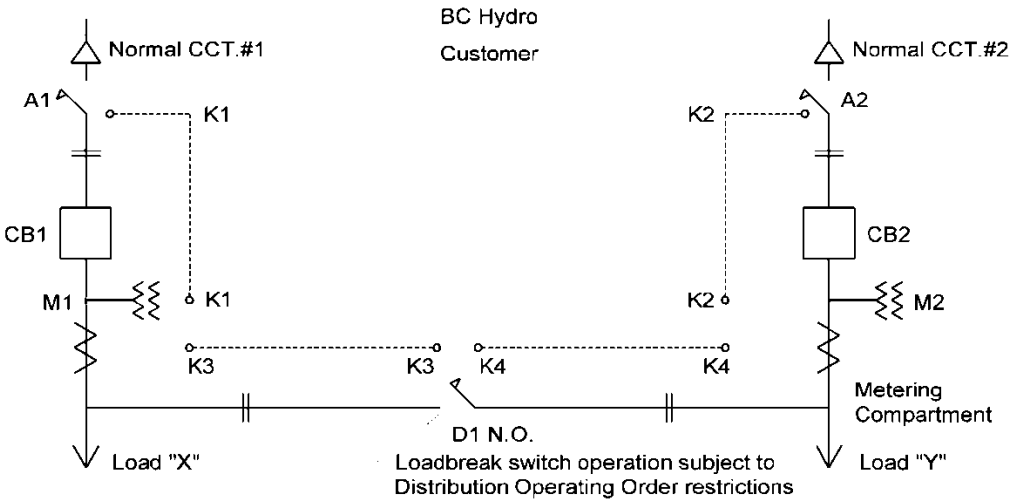

PG A1-01 One Line Diagram Single Radial Supply Typical for U/G Supply Service




PG A1-02 One Line Diagram Single Radial Supply Typical for O/H Supply Service




PG A2-01 One Line Diagram Dual Supply




Purpose of Key Interlock System

1. Allows momentary paralleling of either of the circuits during load transfer.
2. Prevents unsafe operation of disconnect switches and unsafe access to circuit breaker or metering compartment.

Key Interlock Sequence:

I. Access to BC Hydro metering compartment M1:
Open load-break switch A1 and release key K1. Retrieve K3 from D1 which is locked open. Insert K1 and K3 into M1 and open BC Hydro metering compartment M1. Follow the same procedure to access metering compartment M2.

II. To feed load "X" by normal circuit #1:
Open D1. Remove K1 from metering compartment M1. Insert K1 into A1 and close loadbreak switch A1 to feed load "X". Close circuit breaker CB1. Energizing the circuit follow the same procedure when feeding load "Y" by normal circuit #2.

III. To transfer load "X" from normal circuit #1 to circuit #2:
Close load-break D1 (K3 held captive). Momentarily parallel normal circuit #1 with circuit #2. Open load-break A1 and release key K1. Load "X" is now transferred to CCT #2. Similar procedure applies when transferring load "Y" from normal circuit #2 to circuit #1.

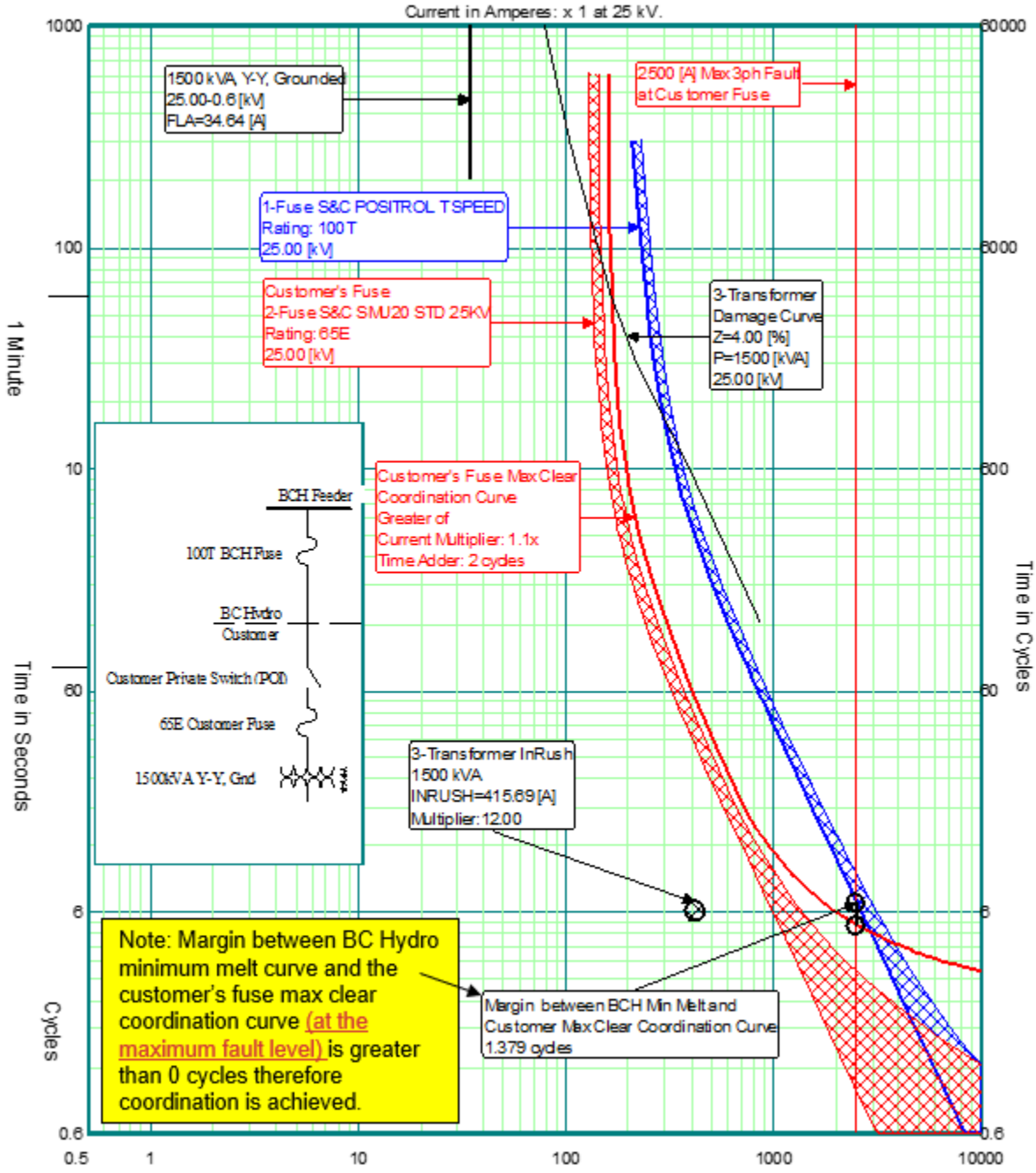
Note:

1. Key interlock is required between the circuit breaker and switch.
2. Distribution Operating Order (DOO) is required for Dual Supply installations.
3. For drawing legend refer to PG Z1-01.

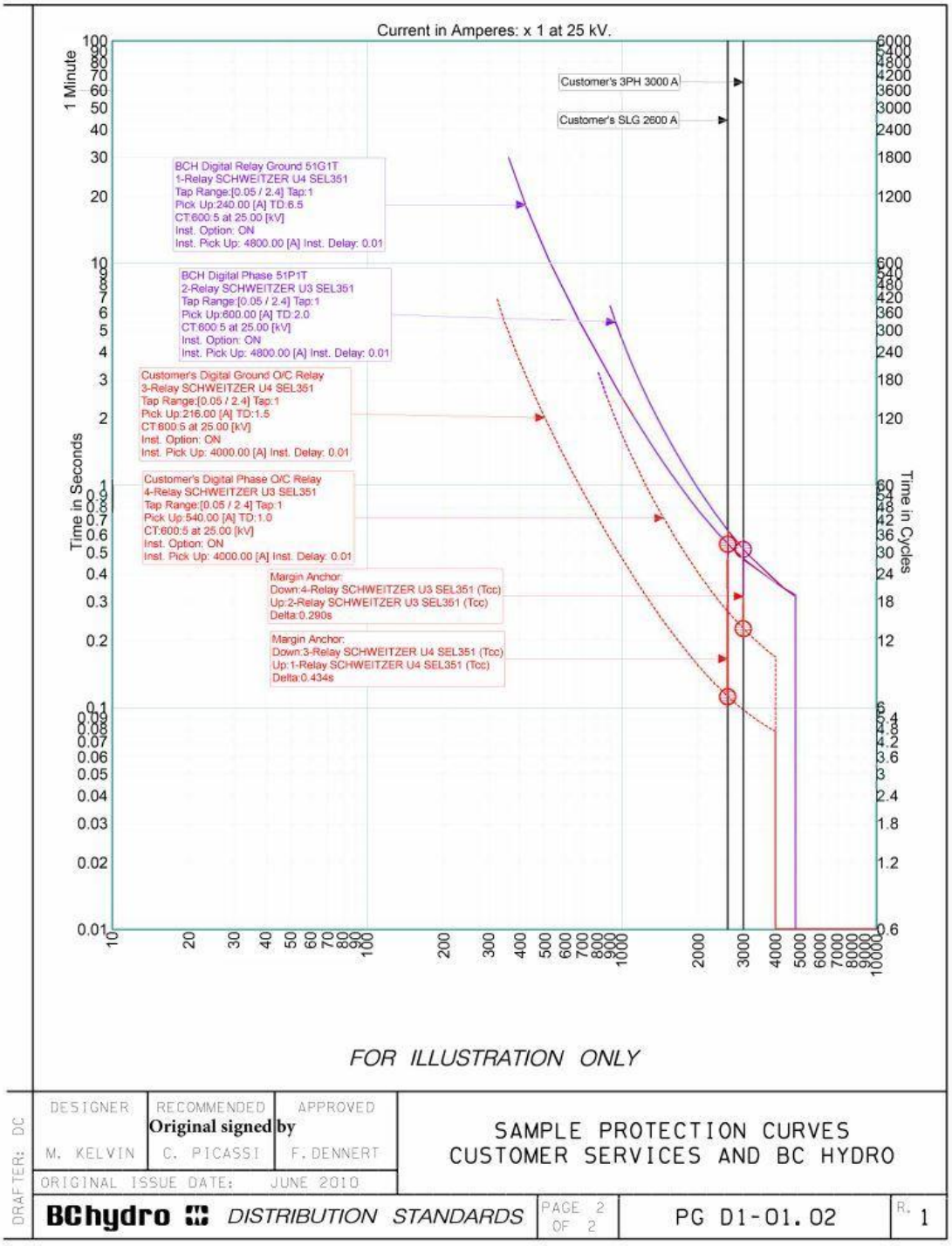
| | | | |
|---|---|---|---|
| Original signed by | | DUAL SUPPLY SERVICE FOUR KEY INTERLOCK | |
| BChydro DISTRIBUTION STANDARDS | | PG A2-02 | 1 |

PG A2-02 Dual Supply Service Four Key Interlock

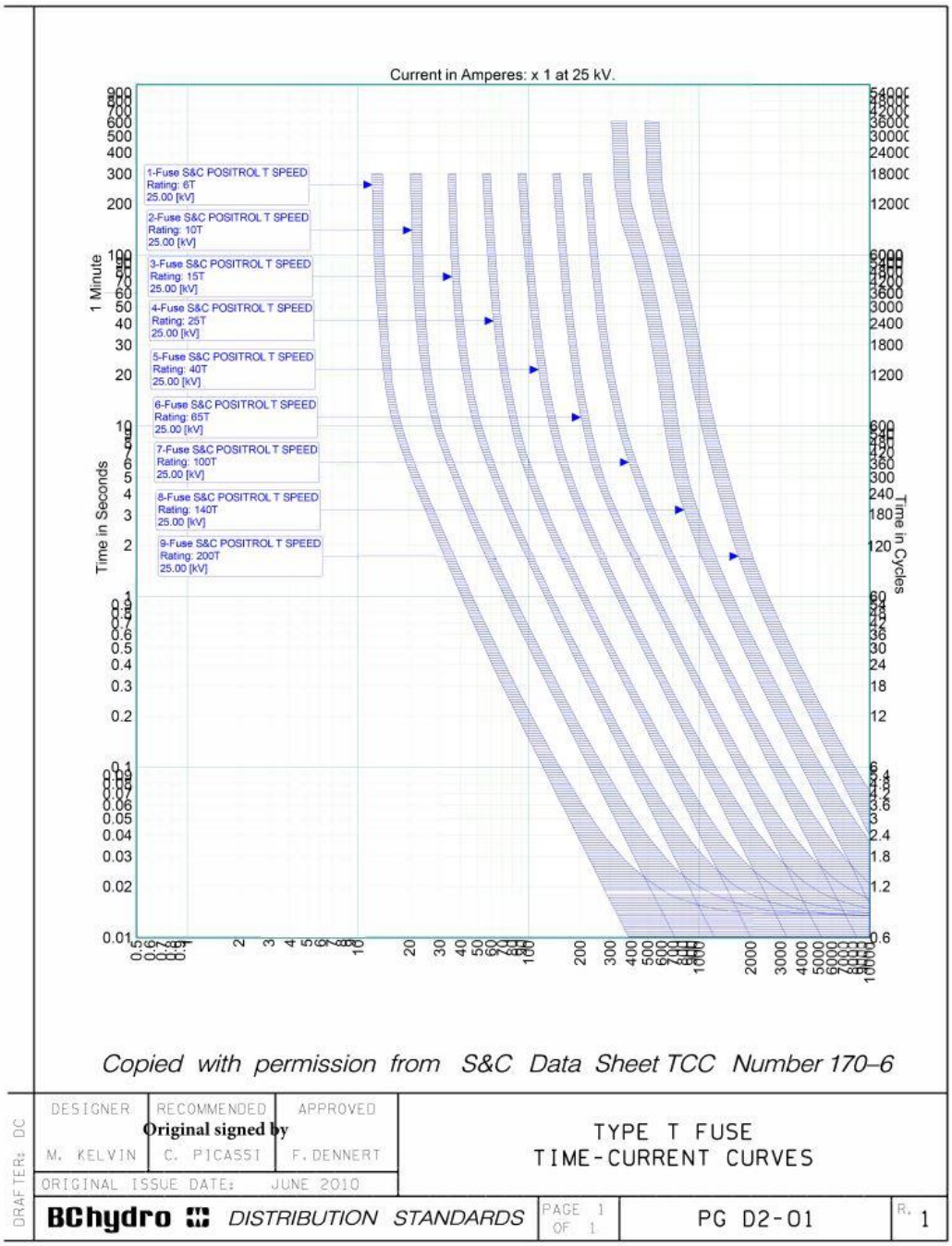
## D Protection Coordination



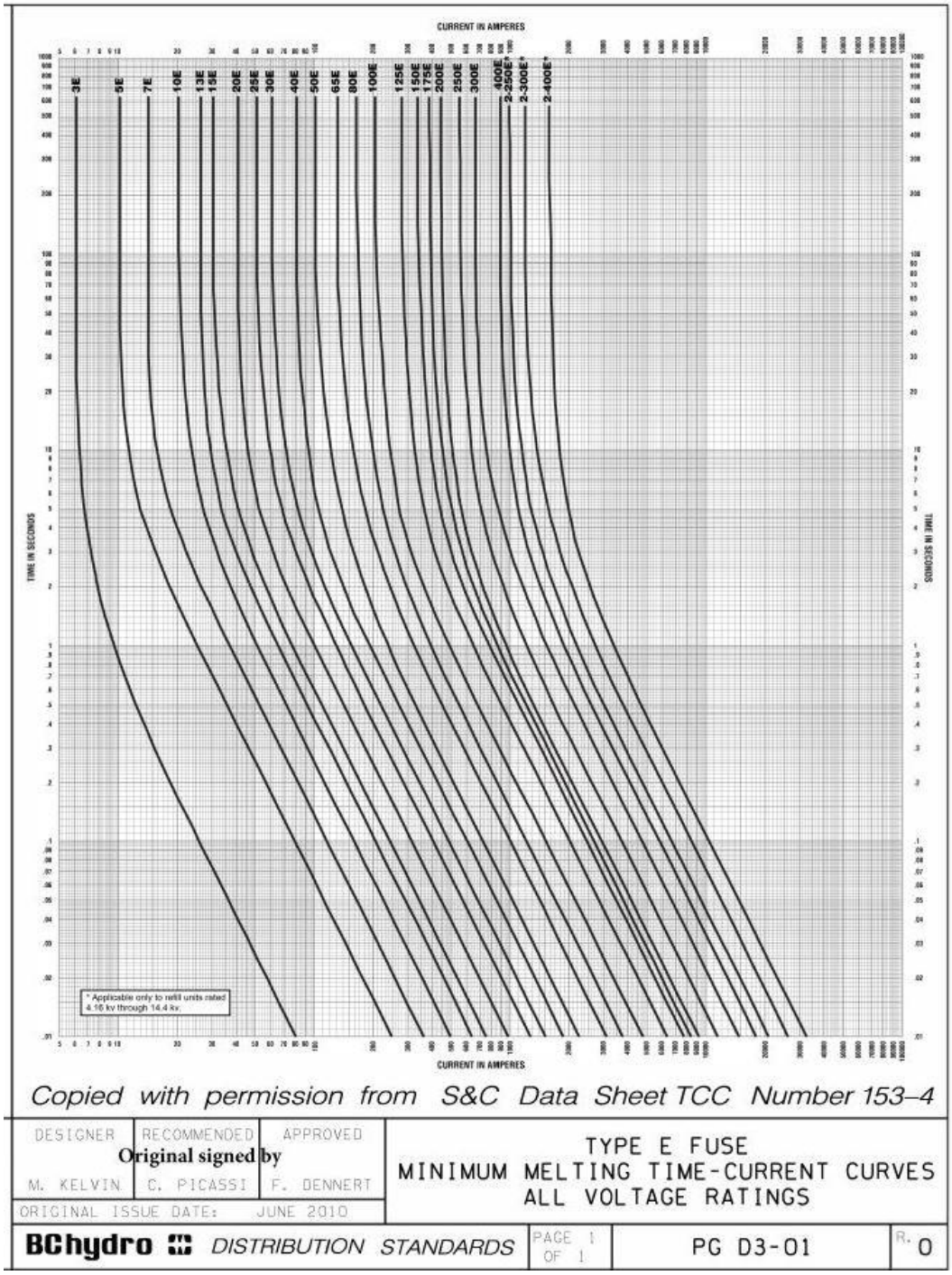

PG D1-01 Sample Protection Curves Customer Services and BC Hydro (page 1 of 2)



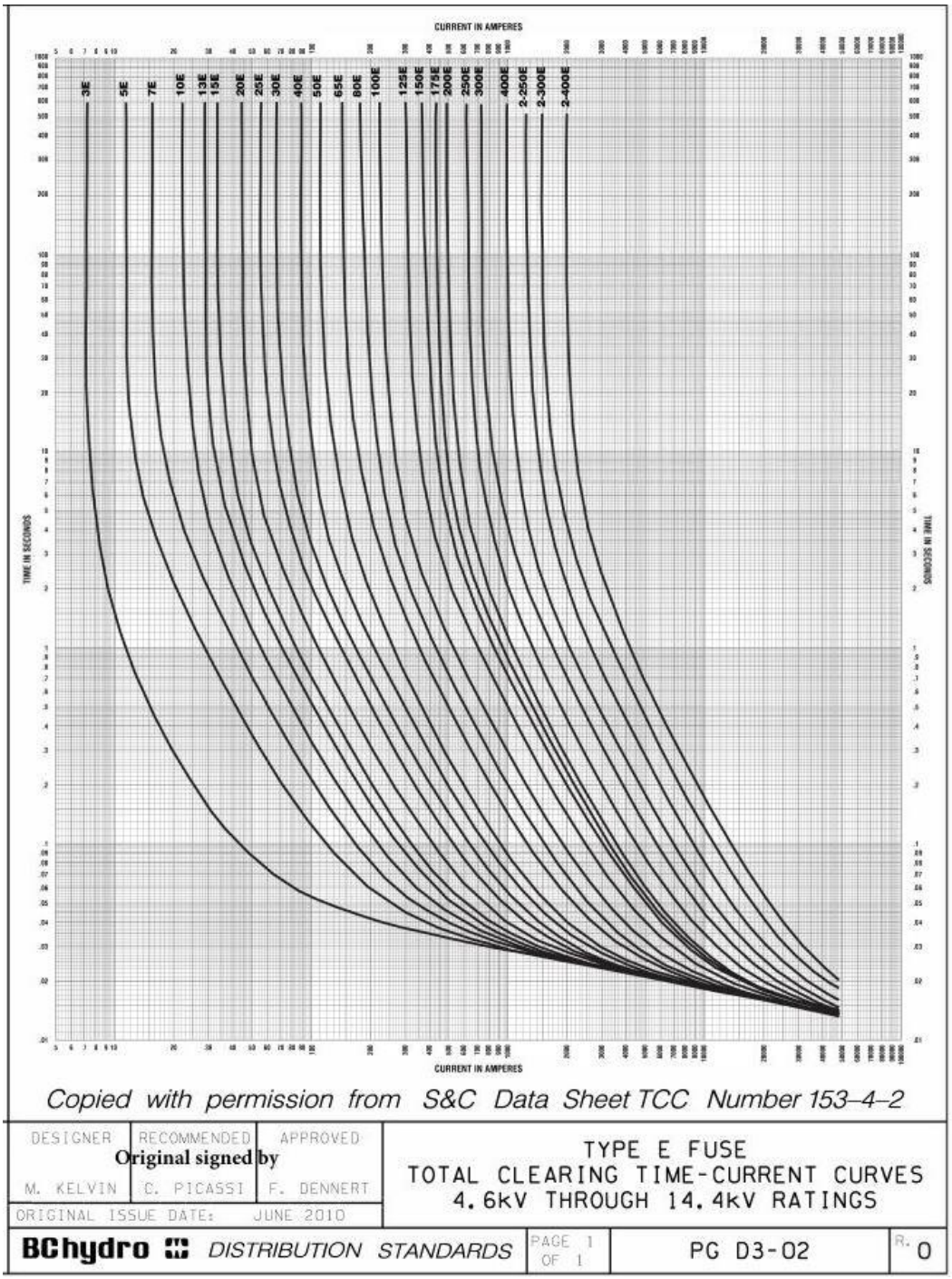

PG D1-01 Sample Protection Curves Customer Services and BC Hydro (page 2 of 2)



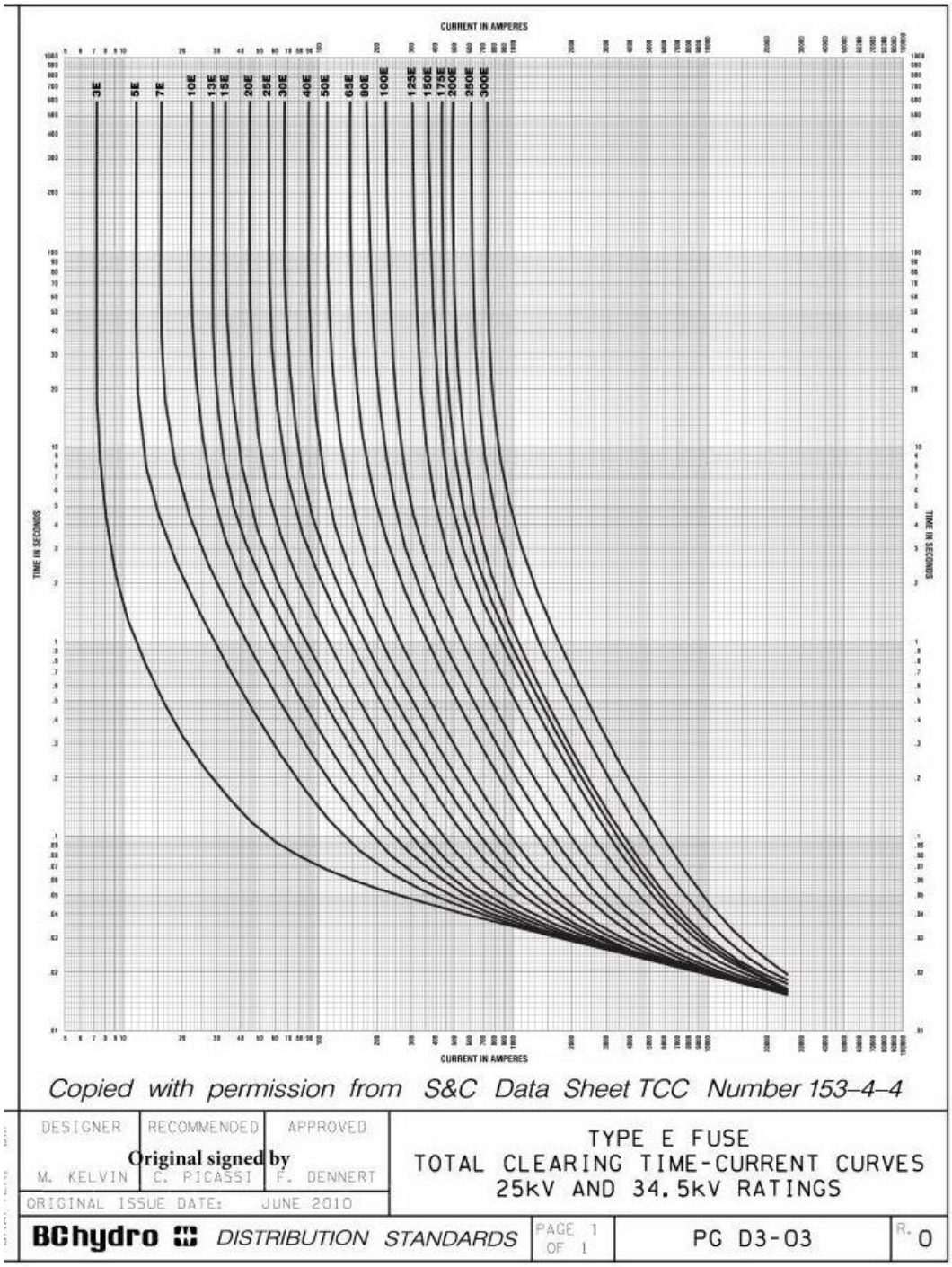

PG D2-01 Type T Fuse Time-Current Curves




PG D3-01 Type E Fuse Minimum Melting Time-Current Curves All Voltage Ratings

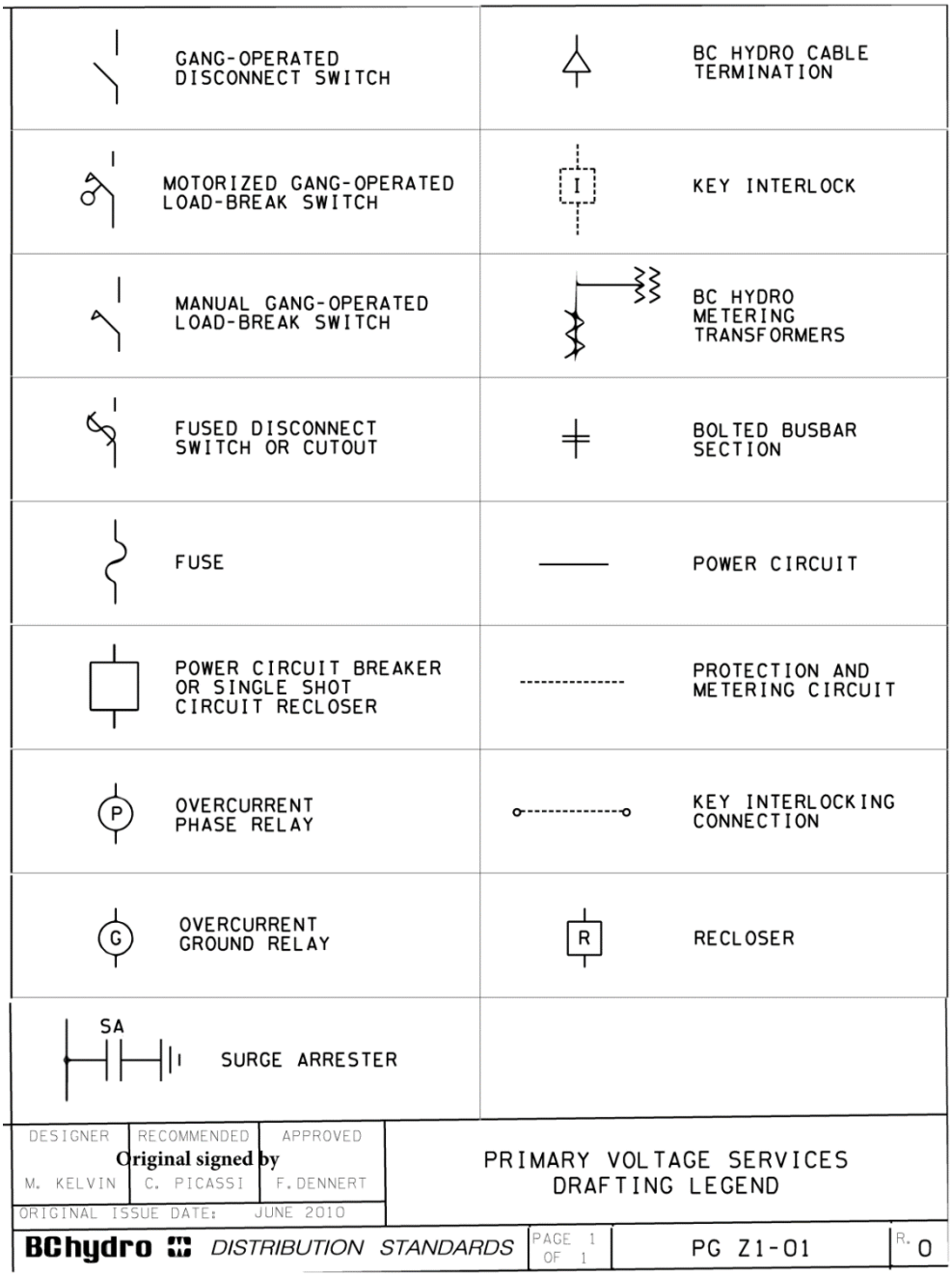



PG D3-02 Type E Fuse Total Clearing Time-Current Curves 4.6 kV and 14.4 kV Ratings




PG D3-03 Type E Fuse Total Clearing Time-Current Curves 25 kV and 34.5 kV Ratings

## Z Engineering Data




PG Z1-01 Primary Voltage Services Drafting Legend

# Appendix 2 Reference Documents

Persons using this manual are responsible for ensuring the following reference documents are the most recent versions.

**Appendix Contents**

BC Hydro *Primary Service Connections* Flowchart

BC Hydro Form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment*, revision 2025-01-10 (3 pages)

BC Hydro *Electric Service Agreement*, revision 27 January 2020 (2 pages)

BC Hydro *Checklist of Requirements for Customer-Owned Primary Services Supplied at 4 kV to 35 kV (Primary Guide)*, revision 2025-01-30 (2 pages)

BC Hydro Decal 9700-3719 *Notice No Storage Allowed*

BC Hydro Decal *Vault Identification Number*

BC Hydro Decal 9700-3120 *Building Electrical Service*

BC Hydro Decal 9700-4268 *Danger Keep Out*

BC Hydro Primary Service Cable Marker Plate

# Primary Service Connections

- O Need a primary distribution voltage service connection (4kv to 35 kv)
- O Need a line on private property—not for utility takeover
- O Need to reconnect a primary service
- O Need to upgrade or alter an existing private line?
- O Require a larger service than typically supplied by BC Hydro?

Start here if you know and have the information needed

| Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 | Step 7 | Step 8 | Step 9 | Step 10 | Step 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Advise BC Hydro of Primary Service Request** | **Provide Preliminary Information** | **Customer's Electrical Design** | **Formal Application** | **BC Hydro Acceptance for Construction** | **Customer's Construction** | **Acceptance for Fabrication (if applicable)** | **Pay for Offsite Works, Onsite Materials** | **Inspections** | **Commissioning** | **BC Hydro Authorization for Connection** |
| **Contact** BC Hydro (Electrical Connection Centre) (phone or web) | **Provide** the information outlined in 5.1.1 of the Primary Guide | **Engage** an EGBC Professional Engineer to start work on the Electrical Design and Formal Application for Primary Service | **Make** a Formal Application with P. Eng. stamped design and all deliverables<br>As per Tech Feas Review Reqts and 5.2 &5.3 of the Primary Services Guide<br>**Pay** design deposit | **Receive** formal acceptance<br>(or partial acceptance pending kiosk/ unit–sub Switchboard fabrication drawing submittal and acceptance—5.3) | **Obtain** electrical permit from AHJ and start electrical construction when authorized | **Submit** fabrication drawings of Primary Service Kiosk or Switchboard, Unit Sub (if these were not already submitted as part of Step 4)<br>As per 5.3 of the Primary Guide | **Pay** quoted amount, pick up any BC Hydro provided materials for Customer's onsite electrical construction | **Arrange** BC Hydro Rep to inspect work at required stages (eg. mandrel of conduit) and all other inspection authority requirements | **Submit** all final deliverables—Primary Service Commissioning Report eg. authenticated record drawings by the POR(s) drawings, electrical permit etc. (as per 5.4 of Primary Guide) | **Service energized** |
| **BC Hydro will:** **Provide** you with letter outlining initial information you need to provide and refer you to the Primary Guide | | **BC Hydro will:** **Work** with you to understand your project scope Undertake a Technical Feasibility Review<br>**Provide** you with details of the servicing requirements to be met & deliverables to be submitted back to BC Hydro (5.1.2)<br>**Request** a Design Deposit | **BC Hydro will:** **Work** with you and/or your engineer or utility representative on aspects of your design to meet requirements.<br>**We will respond within 4 weeks,** either confirming acceptance or providing details of deliverables to be adjusted to reach acceptance | **BC Hydro will:** **Design and provide** a quote for any "offsite" work to connect to your point of service (this could include some civil required on your site) and also the estimate for the onsite materials that are to be provided by BC Hydro | **BC Hydro will:** **We will respond within 4 weeks,** either confirming acceptance or providing details of deliverables to be adjusted to reach acceptance | **Step 8** **Switchboard, Sub, Kiosk Fabrication** Order fabrication | **BC Hydro will:** **Arrange** for BC Hydro Rep attendance/ inspection (eg. Civil Inspector) | **BC Hydro will:** **Undertake** final inspection<br>**We will respond within 4 weeks,** either confirming acceptance or providing details of deliverables to be adjusted to energize<br>**Build/finalize** any ancillary BC Hydro works<br>**Energize** your service and<br>**Start billing** | |

CX–5476

BC Hydro
Power smart

# Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment

The customer or representative provides this statement to BC Hydro knowing that BC Hydro intends to rely upon it.

BC Hydro may refuse to supply electricity to the customer or suspend or discontinue the supply if, in BC Hydro's judgement, the equipment is not compatible with or suitable for the BC Hydro electrical system.

The judgement by BC Hydro of the equipment shall not be construed by the customer or others as an endorsement of the design or as a warranty by BC Hydro of the equipment for the purpose of the customer or others than BC Hydro.

| Project: | Location: | Owner/developer: |
|---|---|---|
| Service: U/G ☐ O/H ☐ | At kV | Expected service date: |
| Type of service equipment: O/H structure ☐ Unit sub. ☐ Outdoor ☐ Indoor ☐ Vault ☐ | | |
| Required drawings: One-line drawing number: Site plan drawing number: Equipment layout drawing number: | | |

**Entrance Transformers**

| Bank kVA | High-voltage winding | | | | Low-voltage winding | | | | High-voltage taps | | | | On-load tap changer (±__%) | Impedance % on bank kVA base (ONAN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volts | Delta | Y | Y grounded | Volts | Delta | Y | Y grounded | Above rated volt | | Below rated volt | | | |
| | | | | | | | | | No. | % | No. | % | | |
| | | ☐ | ☐ | ☐ | | ☐ | ☐ | ☐ | | | | | | |
| | | ☐ | ☐ | ☐ | | ☐ | ☐ | ☐ | | | | | | |
| | | ☐ | ☐ | ☐ | | ☐ | ☐ | ☐ | | | | | | |
| | | ☐ | ☐ | ☐ | | ☐ | ☐ | ☐ | | | | | | |

**Service Entrance (complete I or II)**

I. Circuit breaker

| Rated maximum voltage: kV L-L, rms | Rated continuous current: A, rms | Rated short-circuit current: kA SYM rms | Rated interrupting time: cycles | Trip coil: Current trip A (AC) or shunt trip V (DC) |
|---|---|---|---|---|
| | | | | |

II. Fuse protection (fuses preceded by a loadbreak switch)

(A) Switch (specify mounting): Pole ☐ Structure ☐ Cubicle ☐

| Rated maximum voltage: kV L-L, rms | Rated load-interrupting current: A, rms | At: % PF | Rated short-time withstand current magnitude: A | Rated short-time withstand current duration: seconds | Manufacturer: | Approved certification mark per TSBC bulletin B-E3 071019 3: Yes ☐ No ☐ |
|---|---|---|---|---|---|---|
| | | | | | | |

(B) Fusing

| Manufacturer: | Manufacturer type designation: | Rated continuous current: | Rated maximum voltage: | Fuse characteristics: |
|---|---|---|---|---|
| | | A, rms | kV L-L, rms | |



BC Hydro Form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment*, (page 1 of 3)

**Interconnection Protection**

| Protection | Manufacturer | Type or style |
|---|---|---|
| ☐ Ground overcurrent | | |
| ☐ Phase overcurrent | | |
| ☐ Negative sequence overcurrent | | |
| ☐ Over ☐ Under voltage | | |
| ☐ Over ☐ Under frequency | | |
| ☐ Synchronizing check | | |
| ☐ Reverse power | | |
| ☐ Differential | | |
| ☐ Under frequency load shedding | | |
| | | |
| | | |

Are CTs adequate to operate relays and current trip coils where applicable for all current magnitudes from minimum trip to maximum fault duty?
Yes ☐ No ☐ based on maximum fault duty of _____ MVA

**Metering**

Pole metering Yes ☐ No ☐
Vault or indoor unit sub. Yes ☐ No ☐
Outdoor or unit sub. Yes ☐ No ☐

| Estimated maximum demand | |
|---|---|
| Initial | Future |
| _____kW | _____kW |

| Metered voltage |
|---|
| Rate schedule |

**Customer Generation**

☐ No customer generation

☐ Customer generation not parallel to BC Hydro supply, transfer switch type:_____
(approved certification mark? Yes ☐ No ☐)

☐ Customer generation parallel to BC Hydro supply but with no agreement to sell electricity to BC Hydro.
This would either be a load displacement proposal (https://app.bchydro.com/content/dam/BCHydro/customer-portal/documents/accounts-billing/electrical-connections/load-displacement-form.pdf ) or a closed transition transfer proposal (https://app.bchydro.com/content/dam/BCHydro/customer-portal/documents/distribution/dgi/DGI-CTT-Application-Form.pdf). Both require separate applications.

☐ Customer generation parallel to BC Hydro supply with intent to sell electricity to BC Hydro
A formal distribution generation interconnection application (https://app.bchydro.com/accounts-billing/electrical-connections/distribution-generator-interconnections.html?WT.ac=ec_ec_dgi ) is required.



BC Hydro Form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment*, (page 2 of 3)

| | | |
|---|---|---|
| Professional engineer seal<br><br>Permit to practice number | Professional engineer seal<br><br>Permit to practice number | Professional engineer seal<br><br>Permit to practice number |

| | |
|---|---|
| Company | BC Hydro |
| Signature | Received by |
| Date | Date |



BC Hydro Form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment*, (page 3 of 3)

BC Hydro
Power smart

**ELECTRIC SERVICE AGREEMENT** made the _____ day of _____ 20 .

BETWEEN:

_____
_____
_____
**GST/HST**
**Registration #** _____
("the Customer")

AND:
**British Columbia Hydro & Power Authority**
("BC Hydro")

WITNESSES that the Customer and BC Hydro agree as follows:

1. This Agreement covers electrical service to the premises located at

2. The supply of electricity shall be alternating current phase wire, having a frequency of approximately 60 hertz metered at a nominal potential of volts and delivered at a nominal potential of volts at the Point of Delivery, subject to normal variations from the said frequency and voltages.

   ☐ Secondary Metering ☐ Primary Metering

3. The electricity supplied and taken is subject to the terms and conditions of the Electric Tariff of BC Hydro, including the provisions of Schedule , or amendments thereto or replacements thereof, as filed with and approved by the Utilities Commission. The Customer may inspect the Electric Tariff of BC Hydro during normal business hours at BC Hydro's Head Office or its other general offices and such right to inspect is sufficient notice of the terms and conditions and rate schedules contained therein.

4. This agreement shall continue and remain in force from the date the service is first energized. It shall continue unless terminated by either party giving the other not less than thirty days notice in writing, and it shall, upon expiration of the said notice period, so terminate.

5. BC Hydro owns and is responsible for the maintenance of only the following electrical equipment installed or to be installed at the premises.

   (a) Meters and metering transformers for billing purposes.
   (b) BC Hydro transformers *(see list attached)*.
   (c) BC Hydro rental transformers *(see Rental Agreement attached)*.
   (d) span(s) of primary service connection and/or span(s) of secondary service connection.

   BC Hydro is not responsible for the maintenance of any other electrical equipment located at the premises, including such equipment identified as:

6. The load shall not exceed kW of maximum demand without the prior written approval of BC Hydro.

7. The Customer shall comply with emission limit requirements as provided by BC Hydro and appended to this agreement. For further information, refer to BC Hydro emission limit standards available at www.bchydro.com/distributionstandards ES55 Design Standards - Section Q – Medium Voltage Customer Emission Limits.

8. If required, BC Hydro shall construct to its specifications an extension and/or service connection to supply electricity to the Customer for a Net Construction Cost of $ . Prior to the commencement of construction the Customer shall pay the following charges, as applicable:

| | |
|---|---|
| Extension Fee | $ _____ |
| Connect Charge (Dedicated Facilities) | $ _____ |
| Other | $ _____ |
| Net Customer Contribution in Aid of Construction (CIA) | $ _____ |
| Less Customer Contribution in Kind (CIK) | $ _____ |
| Net Customer Cost | $ _____ |
| GST Customer Cost (BC Hydro GST Regist. No. R121454151) | $ _____ |
| Net Customer Payment/Refund | $ _____ |

9. The Customer shall provide a Guarantee in the amount of $ and in the form of . BC Hydro will hold the Guarantee for a period of years. The amount of the guarantee will be determined by BC Hydro and the maximum amount shall be equal to all or part of BC Hydro's Contribution. At the end of the guarantee period, BC Hydro will re-evaluate BC Hydro's Contribution based on the actual number of Customers and the actual average Billing Demand over the guarantee period. Based on this reevaluation, BC Hydro will return the Guarantee, either in whole or in part, or will return none of the Guarantee. Interest will not be paid on the guarantee.

| British Columbia Hydro & Power Authority | Customer |
|---|---|
| PER: _____ Signature | PER: _____ Signature |
| _____ Printed Name | _____ Printed Name |
| _____ Position | _____ Position |

The following is for Hydro office use only and does not form part of the Agreement between BC Hydro and the Customer.

**Electric Service Agreement**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Customer Name | | Service Details | Wires | Amps | Volts | Phase | |
| Service Address | | | | | | | |
| | | Total Charges | Amount $ | | Receipt No. | | |
| Mailing Address | | Pay As You Go Billing Required? | Yes | | | | |
| Business Partner Number | | | No | Reason | | | |
| Installation Number | | | | Manager's Approval | | | |
| Contract Account Number | | Rate Schedule | | | | | |
| | | Premise Code | | | | | |
| Date Responsible | | Nature of Business | | | | | |
| Electric Service Order No. | | Issuing Office | | | | | |

elecsvcagmt.doc Last revised: January 27, 2020

BC Hydro *Electric Service Agreement*, revision 27 January 2020 (page 2 of 2)

## Checklist of Requirements for Customer-Owned Primary Services Supplied at 4 kV to 35 kV (Primary Guide)

The formal application shall include all documents and drawings as described in the latest revision of the Primary Guide. This checklist is a job aid that can be used to assist in ensuring the completed submission meets BC Hydro requirements.

| **Customer required submission item**<br>**Primary Guide reference: section 5.2.2** | **Check item included in submission** |
|---|---|
| (1) Authenticated by a professional engineer (seal, signature, date) in good standing with EGBC, and displays a permit to practice issued by EGBC. Other engineering associations (e.g. Alberta) are not acceptable.<br>- To prevent delay in the review, the one-line diagram needs to be signed and sealed with the submission package. | ☐ |
| (2) All customer owned service entrance equipment is shown, up to and including secondary revenue metering where applicable. | ☐ |
| (3) Cable and conductor sizes are shown, up to and including secondary revenue metering where applicable. | ☐ |
| (4) Available fault levels at operating voltage and future/alternate operating voltage where applicable. | ☐ |
| (5) Interrupting ratings of the overcurrent protection devices, if not already included in a protection coordination or arc flash hazard assessment study. Location and rating of surge arresters. | ☐ |
| (6-1a) Rating (e.g. kW, kWe, kVA, kVAR, PF), make, and model of the emergency standby generator and associated open-transition transfer switch, and a copy of the approval certificate issued by an accredited organization under section 10 of the *Safety Standards Act*, or drawings/manuals that state this equipment is approved by an accredited organization under section 10 of the *Safety Standards Act*; OR | ☐ |
| (6-2a) Rating (e.g. kW, kWe, kVA, kVAR, PF), make, and model of the emergency standby generator and the completed application form and required details for any closed-transition ("bump less") transfer switches per BCEC section 84 *Interconnection of electric power production sources* for review and approval by BC Hydro Distributed Generator Interconnections.<br>CAUTION: This requires additional work for both BC Hydro and the customer. Refer to Distributed Energy Resources - Closed Transition Transfer Interconnection Requirements (CTTIR). | ☐ |
| (7) Use industry standard symbology such as IEEE/ANSI, IEC, or include a legend clearly indicating device functionality. | ☐ |

| **Customer required submission item**<br>**Primary Guide reference: sections 5.2.3 and 10.1.4** | **Check item included in submission** |
|---|---|
| (a) Time-current characteristic curves authenticated by a professional engineer (seal, signature, date) in good standing with EGBC. A standard 4½ x 5 cycle log-log graph used for the coordination study. Service entrance protective device settings shall be compatible and coordinate with BC Hydro's protective equipment (see section 10 *Primary Service Protection Requirements*) BC Hydro may request the customer to submit complex or illegible coordination graphs on 11" x 17" sheets instead of the standard 8½" x 11" sheets. | ☐ |
| (b) Single time-current characteristic curve with upstream BC Hydro protection, customer relay/fuse curves, and transformer magnetizing inrush. | ☐ |
| (c) Indicated maximum fault levels for bolted three-phase faults (LLL) and single line-to-ground (LG) faults, but without cutting the curves at those points. | ☐ |
| (d) Indicated time margins between the BC Hydro protection and customer entrance protection at the maximum fault level and any other fault level that produces minimum time margin (see section 10.1.4 *Interrupting Rating and Minimum Time Margins* for minimum allowable time margins). | ☐ |
| (e) A corresponding text box for each curve providing curve details (relay manufacturer, pickup, time dial, curve type, curve modifiers, current transformer ration, and delay). The customer's total clearing curve shall include the relay/control response time, breaker/recloser interrupting time, and all other propagation and powerup delays. | ☐ |

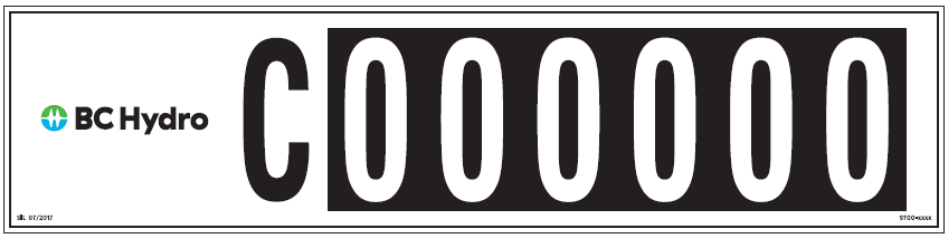
## Checklist of Requirements for Customer-Owned Primary Services Supplied at 4 kV to 35 kV (Primary Guide)

| **Customer required submission item**<br>**Primary Guide reference: sections 3.7 and 5.2.4** | **Check item included in submission** |
|---|---|
| (1) Authenticated by a professional engineer (seal, signature, date) in good standing with EGBC, and displays a permit to practice issued by EGBC. | ☐ |
| (2) The location of the building and the primary service vault. If indoor, confirm clearances and pull pit configuration. | ☐ |
| (3) The proposed terminal pole or service cable vault. | ☐ |
| (4) Routing of the overhead line or underground cables on private property to the point of connection. | ☐ |
| (5) BC Hydro road access for line trucks to the first pole and the revenue metering pole if the primary service is overhead line. | ☐ |
| (6) Detailed design layout of any primary vault or outdoor kiosk, showing crew access and emergency escape routes, minimum operating clearances, safety grounding, proposed primary service duct layout, bends, and fittings and pull boxes, as applicable. Duct profile with wall penetration should be included. | ☐ |

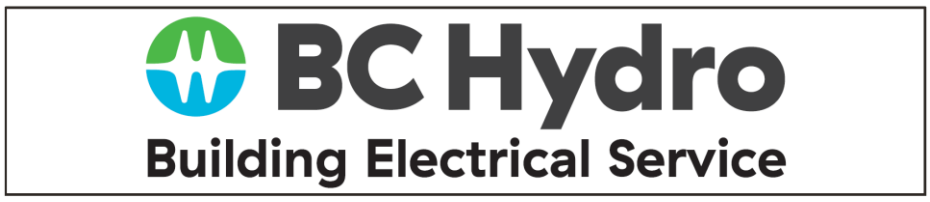
| **Customer required submission item**<br>**Primary Guide reference: sections 3.7 and 5.2.5**<br>**TSBC Information Bulletin B-E3 090312 1 *Overhead line guidelines***<br>**CSA C83 *Communication and power line hardware*** | **Check item included in submission** |
|---|---|
| (1) Authenticated by a professional engineer (seal, signature, date) in good standing with EGBC, and displays a permit to practice issued by EGBC. | ☐ |
| (a) First customer pole shall be a new dedicated minimum class 2 pole, independently anchored through use of customer guying and anchoring (if required), double dead-ended, crossarms and gang-operated loadbreak service switch, and fused cutouts. | ☐ |
| (b) Gradient control mat, ground electrodes, and switch grounding details. | ☐ |
| (c) Conductor separation at the crossarm, phase conductors and neutral separation, neutral conductor attachment separation to ground. | ☐ |
| (d) Fused cutouts (or recloser) mounting details and minimum clearances between devices on the pole. | ☐ |
| (d) Revenue metering new class 2 pole for primary metering. If secondary metered, installation details for service entrance up to meter. | ☐ |
| (f) Pole mounting hardware and components shall be certified to CSA C83. | ☐ |

| **Customer required submission item**<br>**Primary Guide reference: sections 5.2.6** | **Check item included in submission** |
|---|---|
| Signed and sealed BC Hydro form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment* (also known as the primary service declaration) | ☐ |
| (1) Authenticated by a professional engineer (seal, signature, date) in good standing with EGBC, and displays a permit to practice issued by EGBC. | ☐ |


BC Hydro Decal 9700-3719 *Notice No Storage Allowed* (not to scale)

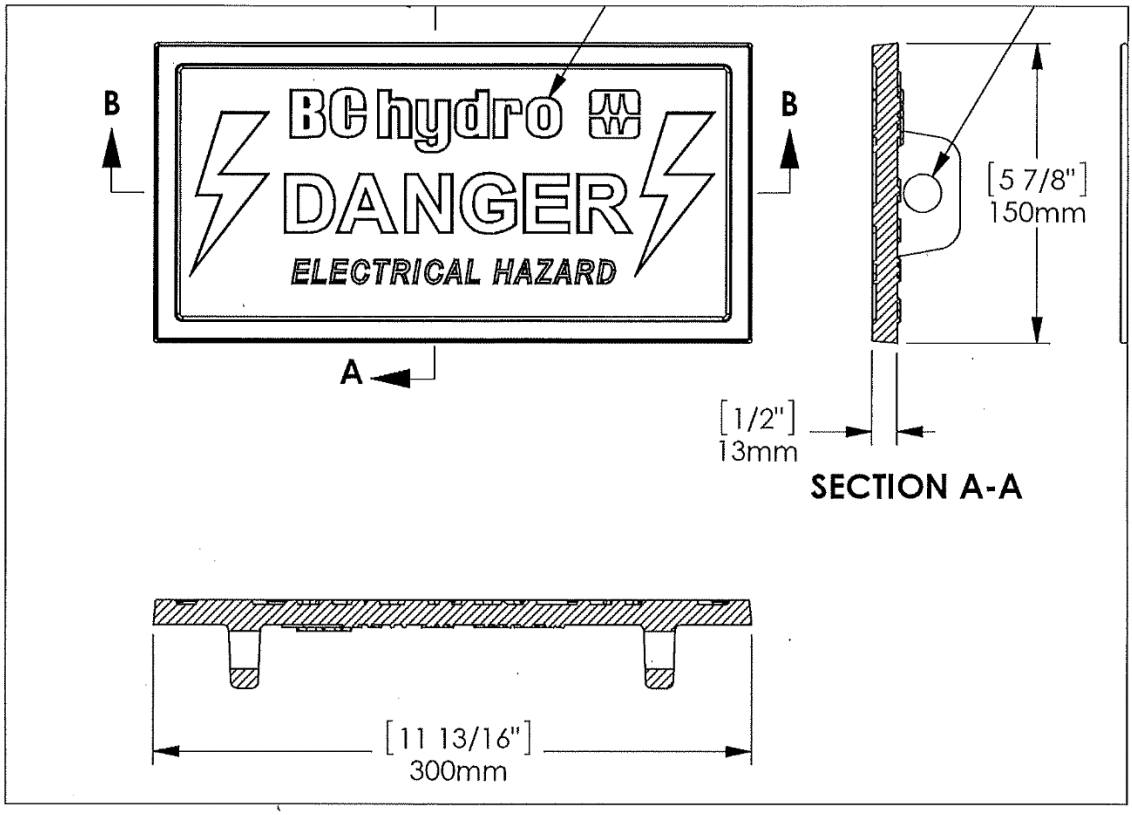



BC Hydro Decal *Vault Identification Number* (not to scale)




BC Hydro Decal 9700-3120 *Building Electrical Service* (not to scale)


BC Hydro Decal 9700-4268 *Danger Keep Out* (not to scale)





BC Hydro Primary Service Cable Marker Plate

# Appendix 3 Photographs

Photographs in this appendix may depict installations which do not meet Primary Guide requirements. Some of these installations were part of a multi-year homologation process, which included multiple “beta sites” for each different equipment design. The non-compliances shown were found to be non-functional in nature and were typically accepted to support advancing BC Hydro’s homologation process. Supply authority requirements for this new technology have changed and improved with time. This appendix shall be considered informative and shall not determine compliance with the Primary Guide.

**Appendix Contents**

**Figure A3-1** – BC Hydro utility service cable compartment (live-front)

**Figure A3-2** – Utility service cable compartment showing disconnect switch and primary bus work (live-front)

**Figure A3-3** – BC Hydro cable termination with ground stud boot removed (live-front)

**Figure A3-4** – Customer-owned primary service fuse compartment

**Figure A3-5** – Primary revenue metering compartment

**Figure A3-6** – Customer fuse compartment with customer primary service cable terminations

**Figure A3-7** – Customer service switch and O/C protection on first pole and BC Hydro primary revenue metering on second pole


**Figure A3-8** – Customer-owned dead-front kiosk with both doors closed


**Figure A3-9** – Dead-front kiosk both doors open showing grounding switch above and service cable bushings below


**Figure A3-10** – Service cable clamps and adjustable cable support channel


**Figure A3-11** – Close-up of dead front BC Hydro utility service cable compartment with terminators, cable supports, and grounding

**Figure A3-12** – Dead front primary service kiosk by Power Systems Technology showing service main

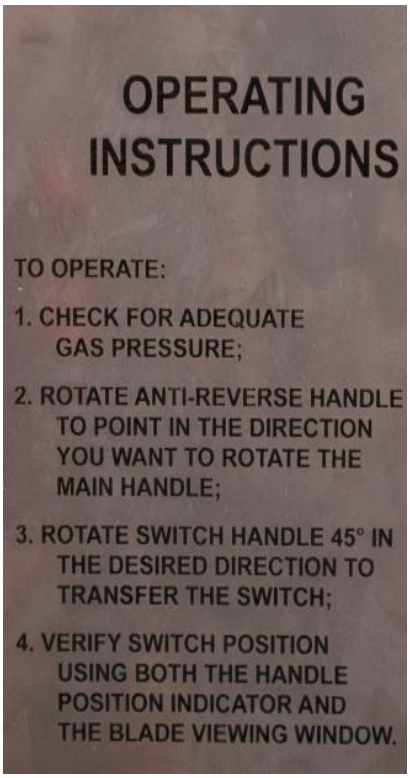



**Figure A3-13** – Operating instructions


**Figure A3-14** – BC Hydro utility cable compartment and cable supports and grounding


**Figure A3-15** – BC Hydro grounding position lock

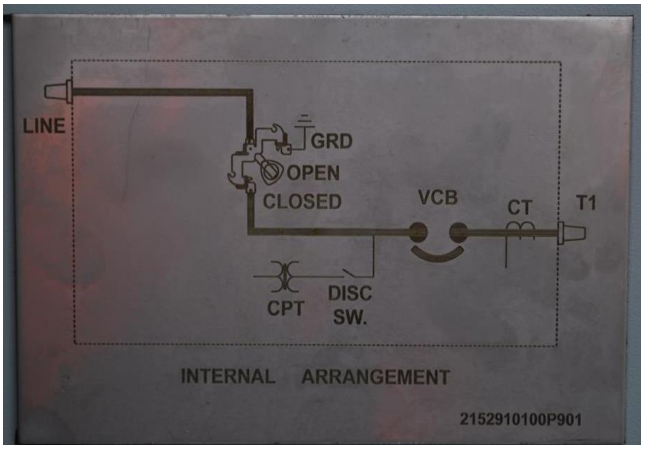



**Figure A3.16** – Mnemonic single line diagram

**Figure A3-17** – Dead-front primary service kiosk by S&C Electric showing BC Hydro as way 1 and customer service main as way 2

**Figure A3-18** – Dead-front primary service kiosk by S&C Electric with BC Hydro as way 1 and customer service main as way 2, covers open

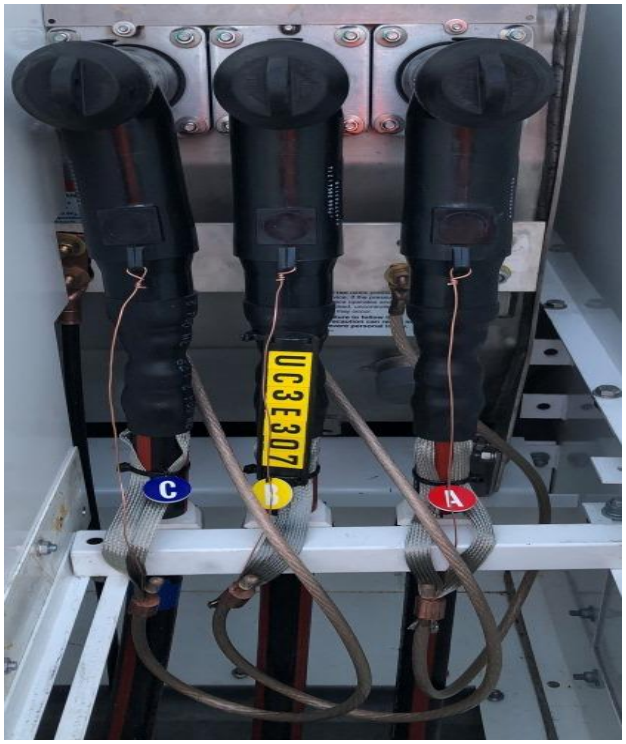



**Figure A3-19** – BC Hydro utility cable compartment and cable supports and grounding


**Figure A3-20** – BC Hydro grounding position lock

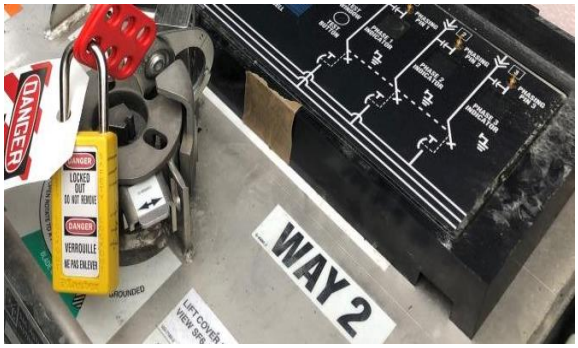



**Figure A3-21** – Mnemonic single line diagram and customer locks