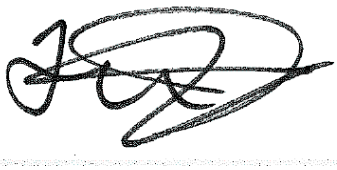
REQUIREMENTS FOR CUSTOMER-OWNED PRIMARY SERVICES SUPPLIED AT 4 kV TO 35 kV

PRIMARY GUIDE

ISSUED: April 30, 2021
EFFECTIVE DATE: September 30, 2021

Rev. No.	Revision Content	Date	POR
0	First issue – internal only, for discussion	Sep 2017	Mark Kelvin
1	External issue – BCSA name change to TSBC	Jan 2018	Mark Kelvin
2	Text revisions and Table 1 deleted	Mar 2018	Mark Kelvin
3	Internal only for discussion – TSBC HV Checklist added, fire protection, editorial revisions, document restructured, various updates, additional requirements added for dead-front equipment	April 2021	Mark Kelvin
3.1	External release of revision 3	April 2021	Mark Kelvin

Recommended		Reviewed		Approved	
 M. Kelvin, P.Eng.		 2021-04-28 A.J. Norris, P.Eng.		 F. Dennert, P.Eng.	
Date:	2021-04-28	Date:	2021-04-28	Date:	2021-04-28

To view the latest version of this document, go to:
http://www.bchydro.com/distributionstandards

Copyright and Reprint Provisions

Reprint Provisions:

For further inquiries, please contact:

BC Hydro Distribution Standards
Mark Kelvin, P. Eng. 604-529-5679

mark.kelvin@bchydro.com

Acknowledgments:

Customer Projects and Applications: Kevin Lim-Kong

Distribution Design: Bojan Bucic, Novy Sandhu, Roy Mendoza, Steven Pountney, Amarjit Sidhu, Sherry Woodford, Srdjan Pocuca

Distribution Engineering: Hristin Stoichev, Josh Patton, Paul Therrien

Distribution Standards: Aaron Norris, Grant Ringham, Mark Stevens

Field Ops: Randy Borsoi, Christopher Smith

Revenue Metering: Rico Luk

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

This *Primary Guide* is neither intended 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 that their use of all or part of this document is appropriate in the particular circumstances.

BC Hydro customers, or their servants or agents, shall recognise the fact that they are, at all times, solely responsible for their own design, construction, installation, and/or operation. Neither BC Hydro, nor any of its employeesor 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 neither be construed as conforming to or endorsing the design, nor as warranting the safety, durability, or reliability of the customer-owned primary service. BC Hydro, because of such review or lack thereof, 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 the customer-owned primary services.

In general, the 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. Furthermore, 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 of or the function of BC Hydro's to interpret or enforce the Canadian Electrical Code as applicable to the customer-owned electrical installation.

Note 2: Revision 3 (2021) of the *Primary Guide* supersedes revision 2 and all previous revisions. Note that a reference to any document external to the *Primary Guide* always implies the most current edition/revision of said document.

2 Definitions

Acceptable — confirms that the customer-owned primary service design and specifications comply with the requirements of the BC Hydro *Primary Guide*.

Annual operating permit — a permit to operate, maintain, and carry out minor alterations to the customer primary service, as per the B.C. *Safety Standards Act*.

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.

Authorization for Connection — a BC Hydro form issued by distribution design authorizing a customer service connection to the BC Hydro distribution system.

BC Hydro designer — 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 Standard C22.1 Canadian Electrical Code Part I, adopted and amended by Technical Safety British Columbia (TSBC) for B.C.

Basic impulse level — as defined by CSA standards.

Conduit — a raceway of circular cross-section through which power cables or conductors are drawn.

CSA 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 — all that 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 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 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.

Electric Service Agreement — formal, legally-binding contract between BC Hydro and the customer that sets forth the terms of supply of electrical energy.

Instrument transformer compartment — a switchgear cell or a section of the primary service assembly containing revenue metering transformers, consisting of an enclosed metal box or cabinet constructed so that it may be effectively locked or sealed.

Isolating switch — a switch intended for isolating a circuit or equipment from its source of supply, which shall not be used for interrupting the flow of current.

Licensed electrical contractor — a person holding a licence as a contractor for the class of electrical equipment or electrical installation defined by TSBC.

Meter cabinet — a 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 — a 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 engineer — a registered professional engineer with qualifications in electrical engineering and registered with EGBC in good standing in B.C.

Protective barrier — a permanent or removable insulation board or fitting, mounted separately from the exposed electrical components, to prevent contact with energized components.

Pull box — an approved metal or concrete box to facilitate installation of service cables or conductors.

Regional distribution engineer — a 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 — a licensed electrical contractor with unlimited voltage restriction and trade qualifications as per the B.C. *Safety Standards Act*.

Regulatory authority — the 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 — a 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 — an 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 — a room or a 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 — an 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 — a switchgear cell or a 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 — a 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 B.C.) — an organization responsible for administering and enforcing the BCEC in B.C.

Visible disconnection point — a 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 of great concern to BC Hydro. All new primary service equipment shall be rated and certified for operation at 14.4/25 kV. Initial operation at 7.2/12.5 kV may be required in some areas. The 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.

All 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. Customer-owned primary services shall also be designed and certified by professional engineers. Any deviations from BC Hydro distribution standards shall be accepted and approved by the BC Hydro regional distribution engineer in charge of the project.

All customer-owned primary services are within the jurisdiction of TSBC and all equipment shall be CSA certified. Installations shall be completed in compliance with the BCEC by a Class A electrical contractor licensed by TSBC and in good standing. Some organizations (e.g. B.C. Ministry of Energy, Mines, and Petroleum Resources, the Vancouver Fraser Port Authority, railway companies). are exempt from the B.C. *Electrical Safety Regulation*, acting as the authority having jurisdiction (AHJ). 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.

If a customer's primary service does not meet BC Hydro requirements, the installation may be connected and maintained under a special provision of 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: The customer-owned primary service equipment, operation, and installation are the jurisdiction of TSBC and the BCEC. BC Hydro will not issue an authorization for connection for any customer-owned primary service prior to receipt of the contractor's declaration and a copy of the annual operating permit held by a Class A licensed electrical contractor from a regulatory AHJ at the site.

The long-term goal for customer-owned primary services is to align the BC Hydro acceptance process with the acceptance practice of TSBC across the province. See TSBC's *High Voltage (HV) Checklist* in Appendix 2 Reference Documents and Distribution Standards for reference only. BC Hydro is working with TSBC, other electrical utilities, municipalities which maintain their electrical inspections, and other AHJs over primary services to develop a common HV checklist for B.C. Electrical contractors will use this proposed HV checklist as a declaration of primary service compliance with the BCEC and BC Hydro standards to the local AHJ, TSBC, and BC Hydro. If a local AHJ waives a future final inspection, a BC Hydro designer will accept an HV checklist signed by a licenced electrical contractor as a declaration of compliance in lieu of a final inspection.

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*.

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

For buildings supplied by an open loop configuration with the BC Hydro switchgear room located inside, BC Hydro requires 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.

For primary overhead services, BC Hydro crews require unobstructed roadway access 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). For overhead supply, the customer service connection includes a pole-mounted loadbreak switch and fused cutouts. For underground supply, the customer service 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: In areas designated by BC Hydro, customers may receive a single radial supply from BC Hydro-owned switchgear located on the customer 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: 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) 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 reliability of service. 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. In some geographic locations, redundancy of the supply system could be provided by BC Hydro-owned switchgear, 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 designer regarding supply configuration for a proposed primary service supply. For further information on special requirements and available feeder capacity, contact a BC Hydro representative.

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*.

For overhead service, the BC Hydro point of connection shall be the first customer-owned pole located on private property.

For underground service, the BC Hydro point of connection shall be the supply service cable compartment. It shall be either apparatus bushings (for dead-front services) or National Electrical Manufacturers Association patterned buses (for live-front services).

For underground indoor service, the BC Hydro point of connection 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.

For underground indoor service in high flood plain areas, the cable pull pit may be replaced by a pull box located outside the building near the primary service, subject to acceptance by a BC Hydro designer.

For underground outdoor kiosk service, pull pits are not acceptable. A pull box must be located within a short distance of the kiosk as per ES54 S3-01 *Primary Services Dead-Front Outdoor Type Kiosk Private Property Installation* and ES54 S3-02 *Primary Services Live-Front Outdoor Type 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. For further information on the requirements of a demarcation structure see Appendix 2 Reference Documents and Distribution Standards.

Note 6: BC Hydro shall not connect any customer service to a building or structure that violates minimum clearance requirements to BC Hydro overhead lines as stipulated by CSA Standard 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 designer 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. The final metering configuration shall be determined in consultation with a BC Hydro designer.

For primary overhead metering, BC Hydro requires a separate dedicated customer-owned new class 2 pole (typically the second pole on a private line) for the installation of a revenue metering assembly and associated surge arresters (see the ES43 J7 primary revenue metering standards in Appendix 2 Reference Documents and Distribution Standards). Customer-owned equipment shall not be installed on a revenue metering pole, except for surge arresters as 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: All BC Hydro primary revenue metering for overhead and underground service connections shall be located after the customer service main overcurrent protection devices.

For primary underground services, BC Hydro requires a separate metering cubicle with access restricted to BC Hydro personnel only. Customer-owned equipment shall not be installed inside a revenue metering cubicle.

For more information on primary metering see the BC Hydro document *Requirements for Manually Read Primary Service Voltage Revenue Metering (4 kV to 35 kV)*.

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.

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

Copies of all 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 – 60.6 Hz), as 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 standard 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, as 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 99th percentile voltage levels measured over a one-week period shall fall within the prescribed CSA range. The analysis excludes measured quantities during outages and/or 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, as per CAN/CSA-IEC 61000-4-30. The 95th percentile voltage unbalance level measured over a one-week period shall be within the prescribed planning level. The 99th 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 which 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. For further information refer to the following BC Hydro emission limit design standards:

(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 CSA certified service mains:

(a) Ganged pole-mounted loadbreak switch and fuses on the first customer pole;

(b) Ganged pole-mounted loadbreak switch on the first customer-owned new class 2 pole and recloser (programmed for one-shot operation) on the second customer pole;

(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 SF6 insulated switches, interrupters, and breakers, indoor and outdoor; and

(g) Live-front or dead-front equipment.

For overhead line primary services, the customer shall install surge arresters close to the load side of the pole-top loadbreak switch, i.e. the opposite side of the H-frame overhead span. For services with primary revenue metering, surge arresters 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 Three-Phase Four Wire* in Appendix 2 Reference Documents and Distribution Standards).

For underground primary services that have primary revenue metering, the customer shall install surge arresters on the load side of the service switch. For services with secondary revenue metering, surge arresters may be installed inside the customer-owned transformer enclosure (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 all affected primary customers to allow adequate time for design and construction of the customer service upgrade.

All 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 as 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. For new services where the customer-owned primary service equipment is initially operated at 12 kV, the equipment manufacturer 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 HV 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

A customer may operate an open-transition standby generator at 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.

For a primary voltage manually-operated open-transition standby generator with mechanical key interlocks, such as in shopping malls or institutions, BC Hydro requires a distribution operating order for safety isolation and disconnection of the BC Hydro utility supply. All interlock schemes which include locking out the BC Hydro primary supply shall be reviewed and accepted by BC Hydro. Mechanical key interlocked devices shall be operated by qualified personnel only.

For primary voltage service with a manually or automatically-operated open-transition secondary voltage standby generator using a fabricated integral transfer switch, BC Hydro shall review and accept only a CSA-certified manually-operated utility supply transfer switch.

For primary voltage service with an automatically-operated open-transition secondary voltage standby generator using a fabricated integral transfer switch, BC Hydro shall only accept a CSA-certified automatically-operated utility supply transfer switch.

For secondary voltage customers with an open-transition standby generator, BC Hydro has transferred all compliance and installation verifications of customer-owned open-transition transfer switches to TSBC

and the electrical AHJ. BC Hydro will only accept CSA-certified utility transfer switches specifically built for this function, as per applicable CSA C22.2 standards. BC Hydro will not accept any custom-built mechanical or electrical interlock schemes replicating the function of a CSA-certified utility supply transfer switch.

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. Refer to 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*.

3.10 Maintenance and Testing

The customer is responsible for regular maintenance and testing of their primary service equipment in accordance with manufacturers' recommendations. 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 and/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 responsibility for equipment maintenance.

For existing dual radial supply customers, WorkSafeBC and BC Hydro safety rules 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 and Distribution Standards for more information on dual radial maintenance requests.

The customer primary service space/vault is designated for restricted access to qualified personnel, as 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 BC Fire Code Regulation, BCEC, and WorkSafeBC Regulation (see the *No Storage Allowed* sign in Appendix 2 Reference Documents and Distribution Standards.)

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 and Distribution Standards. Customers are advised to follow the flowchart to expedite application processing.

3.12 Fire Protection

Where BC Hydro exposed primary service cables pass through a fire-rated building wall or partition, the customer shall install 4-inch diameter Hilti CFS-SL GA L Firestop speed sleeves, one sleeve for each cable. Other fire stops, such as metal duct sleeves filled with spray foam, composite duct seals, or hard cast putty, are not acceptable.

The Fire Marshall for the given jurisdiction 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 or operation shall not obstruct padlocking means in open and/or ground position;

(d) Shunt trip mechanism shall not interfere with manual opening of the service main; and

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

4 Standards and Regulations

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

(a) TSBC *Safety Standards Act*;

(b) TSBC *Electrical Safety Regulation*;

(c) TSBC Directive D-E3 090313 1 *High voltage installations*;

(d) TSBC Directive D-E3 070801 7 *Electrical operating permit requirements*;

(e) WorkSafeBC Occupational Health and Safety Regulation Part 19 *Electrical Safety*;

(f) TSBC Directive D-EL 2017-01 *Exemptions to public utilities*;

(g) TSBC Information Bulletin IB-EL 2017-04 *Electrical safety regulation application to public utilities*;

(h) TSBC Information Bulletin B-E3 090312 1 *Overhead line guidelines*;

(i) BCEC;

(j) BC Hydro distribution standards;

(k) BC Hydro Equipment Advisory 2016-016 *Transfer Switches for Secondary Customer Services Emergency Standby Generators*;

(l) 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*;

(m) BC Hydro *Safety Practice Regulations*;

(n) BC Hydro *Electric Tariff*;

(o) BC Hydro *Requirements for Manually Read Primary Service Voltage Revenue Metering (4kV to 35kV)*;

(p) B.C. *Engineers and Geoscientists Act*;

(q) B.C. Ministry of Energy, Mines, and Petroleum Resources; PO Box 9320, Victoria BC, Tel. 250-952-0793;

(r) CSA C22.2 No. 31-18 *Switchgear assemblies*;

(s) CSA C22.2 No. 41-13 (R2017) *Grounding and bonding equipment*;

(t) CSA C22.3 No. 1-20 *Overhead systems*;

(u) CSA C22.3 No. 7-20 *Underground systems*;

(v) CSA C83-17 *Communication and power line hardware*; and

(w) Institite of Electrical and Electronics Engineers (IEEE) 80-2013 *Guide for Safety in AC Substation Grounding*.

5 Submission Procedures

5.1 Preliminary Design

5.1.1 Customer Submissions

When applying for a new primary voltage electrical service connection or for alterations or upgrades of an existing primary service requiring an electrical permit as per TSBC regulations, the customer should refer to the guidance for electrical service connections at bchydro.com. The customer's consultant should have the following information available for submission to BC Hydro:

(a) Motors 50 HP and larger in 12.5 kV areas and motors 100 HP and larger in 25 kV areas, which may require inrush current mitigation;

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

(c) Flicker generating loads, e.g. arc furnaces, chippers, crushers;

(d) Preferred service type (overhead or underground);

(e) Total connected load in kVA;

(f) Estimated maximum demand in kW as per the BC Hydro Electric Service Agreement;

(g) Emergency standby generators, as applicable;

(h) Service address; and

(i) Planned in-service date.

5.1.2 BC Hydro Response

The BC Hydro designer 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;

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

(e) Expected future supply changes including provision;

(f) Details of the BC Hydro Electric Service Agreement;

(g) Status of the available capacity to supply proposed new load from the existing distribution feeder, demand limits, rapid voltage change limits, flicker emission limits, harmonic current limits, etc.; 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.

In addition to the exchange of information described in 5.1.1 Customer Sumissions and this section (5.1.2 BC Hydro Response), it is recommended customers visit the BC Hydro website for further resources.

5.2 Formal Application

5.2.1 Customer Submissions

The formal application for a new primary service connection, or for alteration or repair of an existing primary service, shall include the following documents and drawings certified by a professional engineer:

(a) An electrical one-line diagram including calculated fault levels, interrupting rating of protective devices, and emergency standby generation as applicable, as per 5.2.2 Electrical One-Line Diagram;

(b) A protective device coordination graph showing coordination between the customer and BC Hydro protective devices, as per 5.2.3 Protective Device Coordination Graph;

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

(d) 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;

(e) 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 designer 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; and

(f) A completed BC Hydro form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment* (see Appendix 2 Reference Documents and Distribution Standards) as per 5.2.6 Primary Service Declaration.

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

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

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 show all service entrance equipment and emergency standby generator connections and shall be certified by a professional engineer. It shall clearly show cable and

conductor sizes, available fault levels, and interrupting ratings of the overcurrent protection devices, proposed service fuse ratings, proposed relay settings, etc. The one-line diagram shall serve as a supplement to the Primary Service Declaration described in 5.2.6 Primary Service Declaration. Conact a BC Hydro designer for primary service cable sizes.

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

(a) Rating, make, and model of the emergency standby generator and the associated open-transition transfer switch, and a copy of the CSA approval certificate or equivalent;

(b) Completed application form and required details for any closed-transition ("bump less") transfer switches as per BCEC Section 84 *Interconnection of electric power production sources* for review and approval by BC Hydro Distributed Generator Interconnections; and

(c) A copy of the TSBC certificate of final inspection after completing installation, which certifies all electrical equipment was installed in accordance with applicable codes and local bylaws.

For further information, see the BC Hydro document *35 kV and Below Interconnection Requirements for Power Generators*.

Note 12: In the event of a malfunction or improper installation of a customer-owned transfer switch and/or standby generator, the owner is responsible for any resulting damage to BC Hydro equipment.

5.2.3 Protective Device Coordination Graph

The customer shall submit time-current characteristic curves certified by a professional engineer (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 and single line-to-ground faults, but 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); 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 13: 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 location of the building and the primary service vault, 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. See 7 Scope of Supply for Primary Services for detailed information and requirements.

To expedite project approval, BC Hydro requires the customer provide a 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. 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. Engineering drawings shall include the following minimum design details as per TSBC Information Bulletin B-E3 090312 1 *Overhead line guidelines*:

(a) First customer new class 2 pole, self-supporting, 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 new class 2 pole as per BC Hydro ES43 standards; and

(f) All pole mounting hardware and components shall be certified to CSA Standard 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 designer, 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 signed and sealed by a registered professional engineer in good standing with EGBC. See Appendix 2 Reference Documents and Distribution Standards for a sample declaration.

5.3 Primary Service Fabrication Drawings Acceptance

The customer shall submit certified fabrication drawings for the proposed primary service switchboard or drawings for a proposed primary service kiosk to BC Hydro for comment and acceptance prior to manufacturing. A BC Hydro designer 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 reviewed and accepted by a BC Hydro designer, 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 14: All supply service cable pull boxes and primary service switchboard cells, cubicles, and compartments which are for the exclusive use of and have access restricted to BC Hydro personnel shall be equipped with a padlocking hasp, BC Hydro security bolts, and/or other security restraining means with sealing provisions as determined by a BC Hydro designer.

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 Type Kiosk Private Property Installation*, ES54 S3-02 *Primary Services Live-Front Outdoor Type Kiosk Private Property Installation*, and ES54 S3-03 *Primary Services Live-Front Indoor Type 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.

For further design and installation details, contact a BC Hydro designer and review the relevant BC Hydro distribution standards and other sections of this *Primary Guide*.

5.4 HV Commissioning Report and Authorization for Connection

Before the final connection authorization inspection, BC Hydro shall receive an HV Commissioning Report certified by a professional engineer, containing the following:

(a) Protective relaying study;

(b) Fault coordination study;

(c) Grid potential rise step-and-touch grounding report, as per BCEC Section 36 *High-voltage installations*;

(d) Service switch or breaker test report;

(e) Protective relaying test report, recorded by injecting primary or secondary test current;

(f) Transformer production and commissioning test report for unitized substations, including an oil analysis report, if applicable;

(g) HV cable test report for service connections involving customer installed cables, if applicable;

(h) "As constructed" engineering record drawings as per 5.2 Formal Application and 5.3 Primary Service Fabrication Drawings Acceptance;

(i) Final inspection certificate from the site inspection AHJ. If a local authority waives the final inspection, BC Hydro shall accept TSBC form 206 *Electrical Contractor Authorization & Declaration of Compliance Electrical Inspection Request* as confirmation of compliance with the BCEC;

(j) Contractor declaration using TSBC form 206 *Electrical Contractor Authorization & Declaration of Compliance Electrical Inspection Request* stating the primary service is completed in compliance with B.C. regulations and the *Safety Standards Act*;

(k) Declaration of compatibility from the professional engineer of record (EGBC quality management guidelines) that all documentation submitted in compliance with 5.3 Primary Service Fabrication Drawings Acceptance and this section (5.4 HV Commissioning Report and Authorization for Connection) meets BC Hydro requirements, and the equipment is ready for energization; and

(l) Copy of operating permit for HV service, including the name and contact information of the field service representative for the primary service installation.

Note 15: If used equipment is installed in the customer-owned primary service, the customer shall provide certified test results reviewed by a professional engineer certifying 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.

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

All 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 as per BCEC Section 36 *High-voltage installations*. A customer applying for connection of temporary primary service shall follow all steps and obtain necessary electrical permits, inspections, and approvals described in 5 Submission Procedures.

Note 16: A temporary service shall meet all 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 voltage of the customer's service.

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

(c) 7.2 kV: single phase;

(d) 25 kV: 14,400 V / 24,940 V grounded wye;

(e) 14.4 kV: single phase; 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 $\pm$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 designer 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

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

In areas where the primary service voltage is 25 kV, the maximum customer service switch sizes rated for 80% continuous operation 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.

For further details and 100% rated services and main switches, please contact a BC Hydro designer.

6.2 Service Transformers

6.2.1 Supply of Service Transformers

BC Hydro will supply and install the necessary transformers for secondary voltage service. The customer will supply and install any 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, as per the BC Hydro *Electric Tariff*.

Note 17: 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.

6.2.3 Service Neutral Connections

The BC Hydro service neutral will be terminated at the customer's grounded neutral bus to maintain primary ground fault continuity regardless of the power transformer primary connection.

If primary voltage revenue metering is installed, the customer's neutral 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 Manually Read 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 Standard 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 Transformer Size and Inrush Current Limitation

Customer-owned transformer inrush current levels shall coordinate with the BC Hydro upstream protective device (recloser, fuse, or relay) during the energization transition period, and shall meet customer emissions limits (see 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

Note 18: For improved service reliability for all customers, the BC Hydro feeder planner may require the installation of a dedicated recloser and request the customer to coordinate new customer primary service protection relays with BC Hydro dedicated recloser relays.

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

Note 19: The location of the first customer-owned pole as the point of delivery shall be selected in agreement with BC Hydro. Thereafter, the pole lines on private property, riser/dip pole, customer-owned unit substations, etc., 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; or

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

Note 20: 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 as 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) and TSBC Directive D-E3 090313 1 *High voltage instructions.* The loadbreak switch shall comply with 10.3.2 Loadbreak Switch;

Note 21: TSBC inspectors do not require a certified grounding report for the safety ground mat at the first customer-owned pole loadbreak switch.

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

Note 22: An exception to (b) applies if the customer chooses to install a utility type recloser as customer-owned overcurrent protection. In this configuration, 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 (27 kV rated for 34.5 kV rural supply) near the primary revenue metering apparatus, as per BC Hydro ES43 J7 primary revenue metering standards (see Appendix 2 Reference Docuents and Distribution Standards); and

(d) A safety ground mat on the second pole below the BC Hydro revenue metering cabinet as 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* (see Appendix 2 Reference Documents and Distribution Standards).

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).

In areas designated by BC Hydro for underground primary open loop service, BC Hydro will supply and install BC Hydro-owned and operated automated switches 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 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 large customer loads or service requiring standby supply from another feeder, the service connection 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 23: All revenue metering equipment and necessary conduits shall be installed by the customer. All control and interconnection wiring is supplied and installed by BC Hydro.

Upon receipt of an application for a new service or for alteration or repair to an existing service, BC Hydro will determine the best available form of underground service in consultation with the customer, in accordance with the designated BC Hydro primary distribution circuit:

(a) Single radial supply: Comprising the incoming cable termination and a gang-operated disconnect or loadbreak switch as 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 to which the transformer shall coordinate (see 6.2.4 Transformer Taps).

(b) Primary service dual supply: Comprising two radial supplies as 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 designer; and/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 designer 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

All service ducts (conduits), pull boxes, and/or 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 regulations, with reference to CSA Standard 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 as per 8 Primary Service Construction;

(c) All 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 as per 8 Primary Service Construction;

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

(g) A primary service switchboard meeting the requirements of 9 Primary Service Switchboard Construction; and

(h) 18 kV rated surge arresters, or 27 kV arresters for rural 34.5 kV supply.

7.4.1 BC Hydro Supply Point Located Inside Customer Building

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

As the BC Hydro supply point is located inside the customer building, the BC Hydro supply service cables shall run between the BC Hydro switchgear vault and the customer primary service vault. 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

All service ducts (conduits) and pull boxes on private property shall be installed by the customer in accordance with BC Hydro ES54 underground civil construction standards and TSBC regulations, with reference to CSA Standard 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 as per 8 Primary Service Construction;

(c) All 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

Note 24: The power supply for auxiliary equipment inside the service kiosk, such as heaters, 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.

(e) 18 kV rated surge arresters, or 27 kV arresters for rural 34.5 kV supply.

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 all 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 (27 kV arresters for rural 34.5 kV supply) 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. The BCEC requires:

(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".

All BC Hydro primary distribution systems are engineered and constructed in accordance with certified BC Hydro distribution standards. All 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 all 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 25: If customer-owned equipment poses a safety or operational risk to the BC Hydro distribution system, BC Hydro may disconnect the primary service until the issue has been resolved to BC Hydro's satisfaction.

All primary services shall be built to accommodate 14.4/25 kV primary supply, even though 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 designer 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, as per 7.3 BC Hydro Scope of Supply for Underground Service Connections. All new BC Hydro primary supply service cables are extruded dielectric. Paper insulated lead covered 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 designer 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, within utility-only access pull boxes, within a restricted utility-only access cable pull pit and/or supply service cable compartment. Service ducts located on walls inside a building shall be protected by suitable metal covers and/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 Standard 48 *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 Standard 386 *Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV* and BC Hydro equipment specifications as per BC Hydro standard ES54 S3-01 *Primary Services Dead-Front Outdoor Type Kiosk Private Property Installation* or ES54 S3-03 *Primary Services Live-Front Indoor Type Switchgear Private Property Installation*, as applicable.

Note 26: All supply service cables shall enter the primary supply service cable compartment from the bottom. All 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 duct(s) 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 attachment surface of the mounting provision shall be alligned 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 Type Kiosk Private Property Installation*, ES54 S3-02 *Primary Services Live-Front Outdoor Type Kiosk Private Property Installation*, or ES54 S3-03 *Primary Services Live-Front Indoor Type 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 the next *Primary Guide* revision. In the interim, refer to 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

All service ducts (conduits) on private property shall be installed by the customer in accordance with BC Hydro ES54 underground civil construction standards and TSBC regulations, with reference to CSA Standard C22.3 No. 7 *Underground systems* and all 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 27: A BC Hydro designer 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.

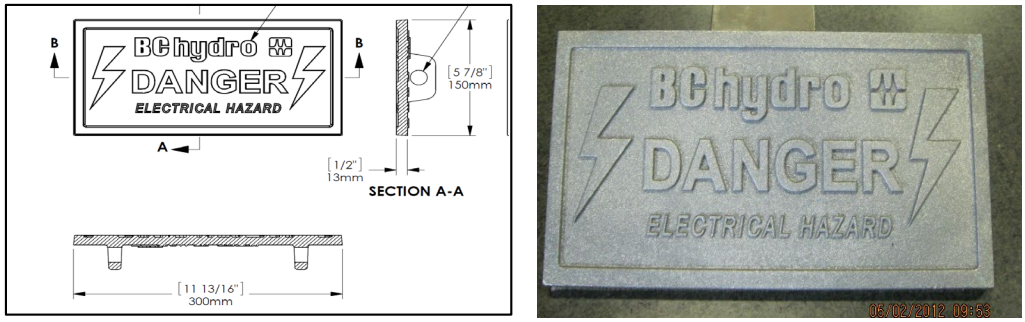


Figure 8-2. BC Hydro primary cable warning plate

Note 28: 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, and/or parkades. Warning plates are stipulated by BCEC Rule 36-100 *Conductors*, paragraph (4), and shall be placed at intervals of 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 Standard 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/ducts 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/or gases.

Note 29: 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 the 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 CSA-certified PVC type DB2 ducts, concrete encased, having 3” (75 mm) minimum concrete cover. Rigid metal conduit as primary service ducts are required by the City of Vancouver.

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

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/or abrasion caused by duct walls. A BC Hydro designer may require the installation of pull boxes at their discretion, particularly if:

(a) The length of service run is longer than 50 metres;

(b) Cumulative duct bends exceed 135°;

(c) Cable pulling tension exceeds acceptable limits; and/or

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

BC Hydro personnel use standard pulling equipment and mandrels which are best suited for the unrestricted diameter of the conduit. 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. All duct end fittings shall be effectively sealed to prevent ingress of sand and other sedimentary materials from depositing inside the ducts.

Note 30: BC Hydro does not accept thin-wall electrical metallic tubing conduits for BC Hydro service cables for installation inside a building or parkade.

All portions of the customer-installed service ducting shall be "proven" by having a suitable mandrel pulled through in the presence of a BC Hydro representative, and all 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/or kiosk pads.

8.2.3.1 Concrete Encasement

Service ducts specified to be encased in concrete shall be CSA-certified 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 any damage to ducts and service cables. A BC Hydro designer 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 S3-03 *Primary Services Live-Front Indoor Type Switchgear Private Property Installation*.

8.2.3.2 Structural Supports

All 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 designer) during the installation and removal of service cables. All 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/or local bylaws as 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 2100 mm. Indirect access by building freight elevators or other methods is not acceptable to BC Hydro.

For slab-on-grade buildings, the vault 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 Type Switchgear Private Property Installation*.

For parkade-type buildings, the customer shall locate the primary service vault in agreement with a BC Hydro designer.

The vault location shall provide satisfactory access to allow unobstructed movement for equipment replacement and personnel access. All personnel access doorways shall be minimum 900 mm (3 ft) wide and equipment loading doors shall be minimum 1200 mm (4 ft) wide. Depending on equipment size, a larger doorway may be required. 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 Manually Read 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 entrance to the vault.

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

Note 31: 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 pits for indoor vaults. All service entrance conduits shall terminate in a cable 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 to train the supply service cables into their compartment. The minimum length of the pull pit shall be 2100 mm to accommodate cable pulling.

Cable pits shall extend outside the primary service switchgear to permit easy installation of supply service cables. See BC Hydro standard ES54 S3-03 *Primary Services Live-Front Indoor Type Switchgear Private Property Installation* showing typical installations for detailed requirements. All cable pits shall be covered by suitable aluminum checker plates as shown in standard ES54 S3-03. All cover plates shall be sized and located for easy removal, taking into account weight restrictions for handling by a single worker (20 kg maximum for a removable section and 40 kg maximum for a hinged section, pursuant to BC Hydro work procedures). 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 designer shall review and accept customer submissions for cable pull pit and checker plate covers prior to construction, fabrication, and installation.

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

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

For services with future expansion requirements, the cable pit 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. It is the customer's responsibility to provide an adequate number of conduits to allow for future expansion, in consultation with BC Hydro.

Proper drainage shall be provided in each cable pit, as 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 designer, as per BC Hydro standard ES54 S3-03 *Primary Services Live-Front Indoor Type 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 the size and design of the cables;

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

(d) Pulling iron(s) as shown in BC Hydro standard ES54 S3-03 *Primary Services Live-Front Indoor Type 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.

8.3.5 Remote Shunt Trip

To facilitate emergency disconnection of customer primary service, dead-front type indoor unit substations shall have a remote shunt trip operated by a maintained contact pushbutton. The pushbutton shall be (¼-turn reset) installed inside a tamperproof box at a readily accessible location outside the electrical vault room, complete with a staple and hasp to accommodate a BC Hydro padlock only. 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 all clearances shall meet the requirements of TSBC, BCEC, BC Building Code, and any other applicable requirements as per local AHJs.

8.4 Outdoor Primary Service Kiosks

BC Hydro continues to work with equipment suppliers to install dead-front type 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 Type Kiosk Private Property Installation* or ES54 S3-02 *Primary Services Live-Front Outdoor Type Kiosk Private Property Installation* as applicable. A cable pull box shall be located as 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 deterioration of components and extends the life expectancy of the service kiosk. For further information, contact a BC Hydro designer.

Outdoor service kiosks shall be a CSA-certified assembly 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 32: 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 and/or conditions should be reviewed with a BC Hydro designer. 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 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 placement of the necessary decals in a prominent manner as per the requirements of this section. Clutter caused by placement of other non-critical unregulated decals and/or 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 the service life and performance of the decals.

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

8.5.1 Indoor Primary Service Vaults

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

(a) Electrical service vault door(s);

(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

Description	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

Description	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

Description	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

For outdoor installations, BC Hydro will apply decals to 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

Description	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

Description	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 standard C22.2 No. 31 *Switchgear assemblies* and shall bear a mark of CSA certification.

Note 33: 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).

Where heaters are required to maintain temperature and to control moisture inside switchboard compartments, a separate heater power supply shall be provided downstream of the metering supply point. 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.

Note 34: To minimize customer outage time caused by fuse operation, it is strongly recommended that spare fuses be supplied and stored in a separate wall mounted cabinet accessible to operating personnel. It is not acceptable to mount the spare fuses inside the switchgear fuse compartment if access to the spare fuses requires a power outage. Re-fusing of customer equipment is the responsibility of the customer's licensed electrician and will not be performed by BC Hydro.

The inside surfaces of compartments with viewing windows shall be painted a light colour to aid visual inspection of switch and/or 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 pentabolt 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 any conductors not directly related to the equipment located within 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 pattern 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 standard 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

For existing dual radial configurations where sections of bus are required to be bolted and removable for equipment maintenance purposes, it is recommended that a sheet metal barrier shall be provided for insertion in the gap when bus sections are removed to help minimize customer outage time. The metal barrier shall be of a slide-type and suitably fastened in storage 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

For outdoor primary service kiosks, BC Hydro requires:

(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 regulations, 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 accept only 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

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 35: 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.

To comply with WorkSafeBC, BC Hydro work procedures, and regulations governing the limits of approach, all 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. 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. For design and installation details, see BC Hydro standards ES54 S3-02 *Primary Services Live-Front Outdoor Type Kiosk Private Property Installation* and ES54 S3-03 *Primary Services Live-Front Indoor Type Switchgear Private Property Installation*, and Figure A3-1 *BC Hydro utility service cable compartment* in Appendix 3 Photographs.

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 all 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.

If a chain is used between an operating handle and a loadbreak or disconnect switch, a guard shall be provided 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 Type Kiosk Private Property Installation* and ES54 S3-03 *Primary Services Live-Front Indoor Type 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 load-break grounding switch to comply with BC Hydro work procedures and *Safety Practice Regulations*. To facilitate this requirement, BC Hydro assumes operating authority over a shared or dedicated switch (depending on equipment design). Further operational and safety requirements for BC Hydro acceptance of customer-owned dead-front primary service equipment designs are described below.

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 designer.

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
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	Equipment under evaluation	Equipment under evaluation

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 be CSA certified;

(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) For outdoor installations, if the switchgear design requires shared operating authority between BC Hydro and the customer, the switch compartment 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 grounding of the service bushings. The switch shall be lockable in the ground position using a BC Hydro padlock. It shall also 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 Standard 386-2016 *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) For switchgear with separate customer and supply authority switches (i.e. S&C Electric VISTA), a key interlock for revenue metering compartment access shall be installed on the customer's switch only;

(m) Switchboard design shall meet all requirements of BC Hydro standard ES54 S3-01 *Primary Services Dead-Front Outdoor Type Kiosk Private Property Installation* or ES54 S3-03 *Primary Services Live-Front Indoor Type 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 regulations 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 36: 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 Type Kiosk Private Property Installation*, ES54 S3-02 *Primary Services Live-Front Outdoor Type Kiosk Private Property Installation*, and ES54 S3-03 *Primary Services Live-Front Indoor Type 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 37: 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. Location of the viewing window and the switch operating handle 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 38: All 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 and Distribution Standards.

9.4 Service Entrance Compartment – Dual Supply

Dual supply service entrance equipment shall meet all 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 39: 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) 95 kV on the 12.5 kV system;

(c) 125 kV on the 25 kV system; and

(d) 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	Fuses and fuse links	
	Symmetrical (MVA)	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 varies depending of the types of protective devices, but shall not be lower than the minimum values defined in Table 10-2 and accompanying notes. For customer relay/recloser protection, both the response time curve and the total clearing time curve shall be shown on the time-current characteristic graph (although margin indications are from the response curve, as indicated in the Table 10-2 notes). The total clearing curve shall include the relay/control response time, breaker/recloser interrupting time, and all other propagation and power-up delays required to clear the fault.

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 (Note 1)	18 cycles (0.3 s) (Note 2)	12 cycles (0.2 s) (Note 2)
Electromechanical relay	18 cycles (0.3 s) (Note 3)	18 cycles (0.3 s) (Note 2)	18 cycles (0.3 s) (Note 2)
Digital relay	12 cycles (0.2 s) (Note 3)	18 cycles (0.3 s) (Note 2)	12 cycles (0.2 s) (Note 2)
Recloser	12 cycles (0.2 s) (Note 3)	18 cycles (0.3 s) (Note 2)	12 cycles (0.2 s) (Note 2)

Table notes:

Note 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.

Note 2: Margin between customers relay/recloser response curve and BC Hydro minimum melt fuse curve or BC Hydro relay/recloser response curve.

Note 3: Margin between customers maximum clear fuse curve and 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.

BC Hydro requires current transformers be located on the source side of the associated circuit breaker to avoid the dead zone in the customer's primary service switchgear protection, and on the load side of the disconnect 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).

If a customer installs current transformers on the load side of a circuit breaker (e.g. draw-out breaker or interlocked switch and interrupter assembly), the customer shall provide verification that this configuration's dead zone is less than one quarter of a cycle. If the same current transformer/relay set on the source side of the breaker is compared to the set on the load side, the additional reaction and propagation delay on the load side shall not exceed one quarter of a cycle.

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 Standard C37.90 *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 HV Commissioning Report and Authorization for Connection.

Note 40: For special applications or a particular service failure, BC Hydro may request the customer have protective relay tests performed by an independent test facility (e.g. Powertech Labs Inc.) for acceptance by a BC Hydro accredited representative.

Overcurrent relays may be arranged as three-phase relays, or as two-phase relays and one ground relay. The latter arrangement is generally preferable and is required for larger installations for coordination with BC Hydro ground relays. 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 BC Hydro's feeder relay 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 protection should be capable of instantaneous phase and ground tripping. If protection operation below three cycles can be guaranteed above an adjustable threshold, it is accepted as instantaneous. The instantaneous element threshold should be set at:

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

(b) Lower than the fault current for which the coordination margin described in the Table 10-2 cannot be guaranteed.

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

Note 41: For existing installations or a particular primary service failure, BC Hydro may request the customer provide an updated certified protective relay tests report and sealed coordination diagrams 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 shall 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.

10.3 Protection with Fuse and Loadbreak Switch

10.3.1 Fuse Size

Fuses shall have time-current characteristics that coordinate with the upstream BC Hydro protective device. The customer shall consult a BC Hydro designer for BC Hydro upstream protective device details for a particular primary service connection at the time of submission (see 5.2.2 Electrical One-Line Diagram).

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; and

(d) The fuse shall coordinate with the BC Hydro upstream protective device.

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

Drawing PG D2-01 *Type T Fuse Time-Current Curves* (see Appendix 1 List of Primary Guide Standards) shows BC Hydro's preferred type T fuse curves. Type T fuse curves have a built-in de-rating factor of approximately 75% so that the maximum clearing time of the customer's fuses will be no greater than 75% of the minimum melting times of BC Hydro fuses. Corresponding type E fuses do not require de-rating. The purpose of the de-rating is to compensate for ambient temperature variance, pre-loading, and pre-damage effects. See the PG D3 drawings in Appendix 1 List of Primary Guide Standards for type E fuse curves.

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.

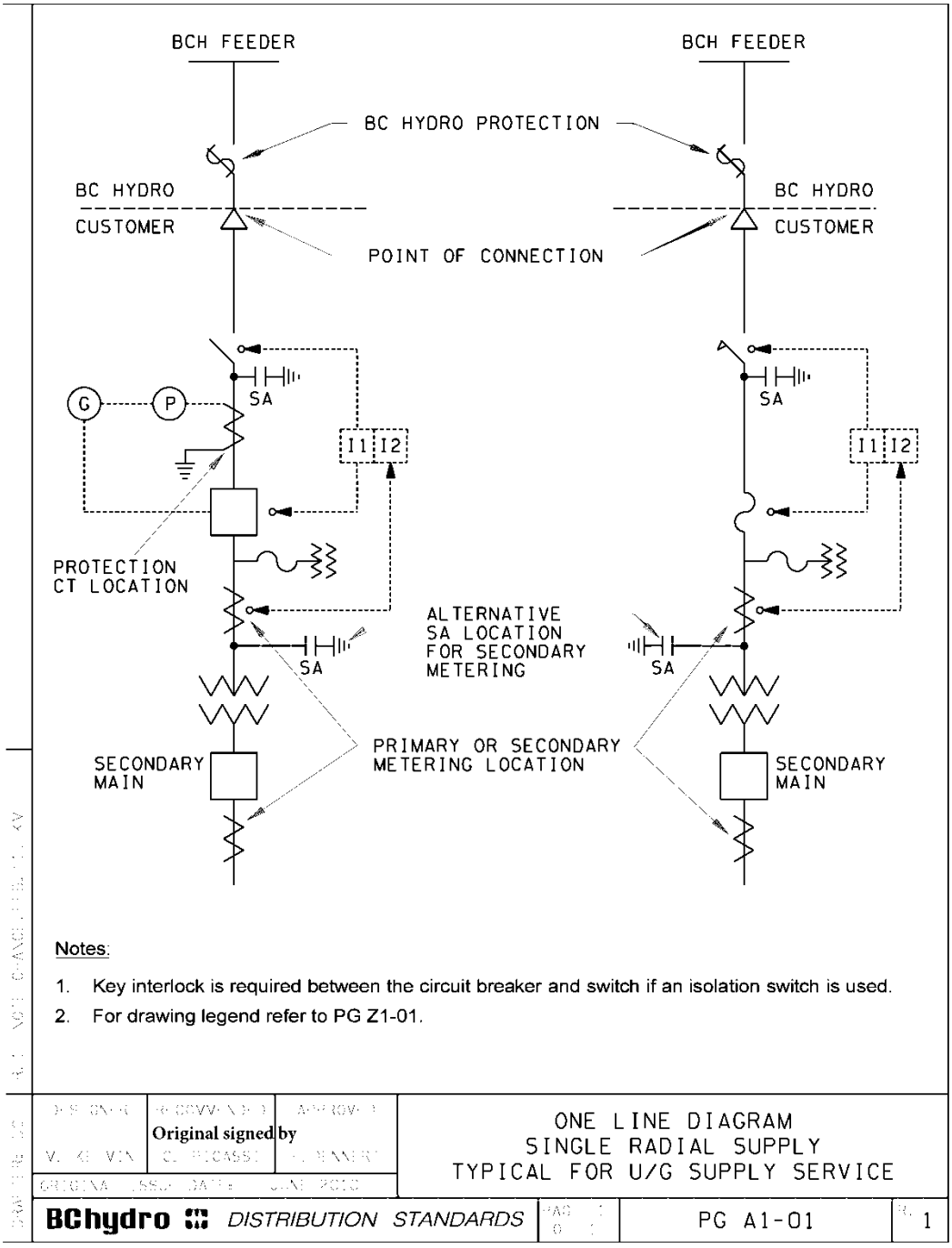
The use of customer-owned loadbreak switches as a primary circuit opening device for secondary ground fault protection is not acceptable for any type of customer-owned primary service applications.

Appendix 1 List of Primary Guide Standards

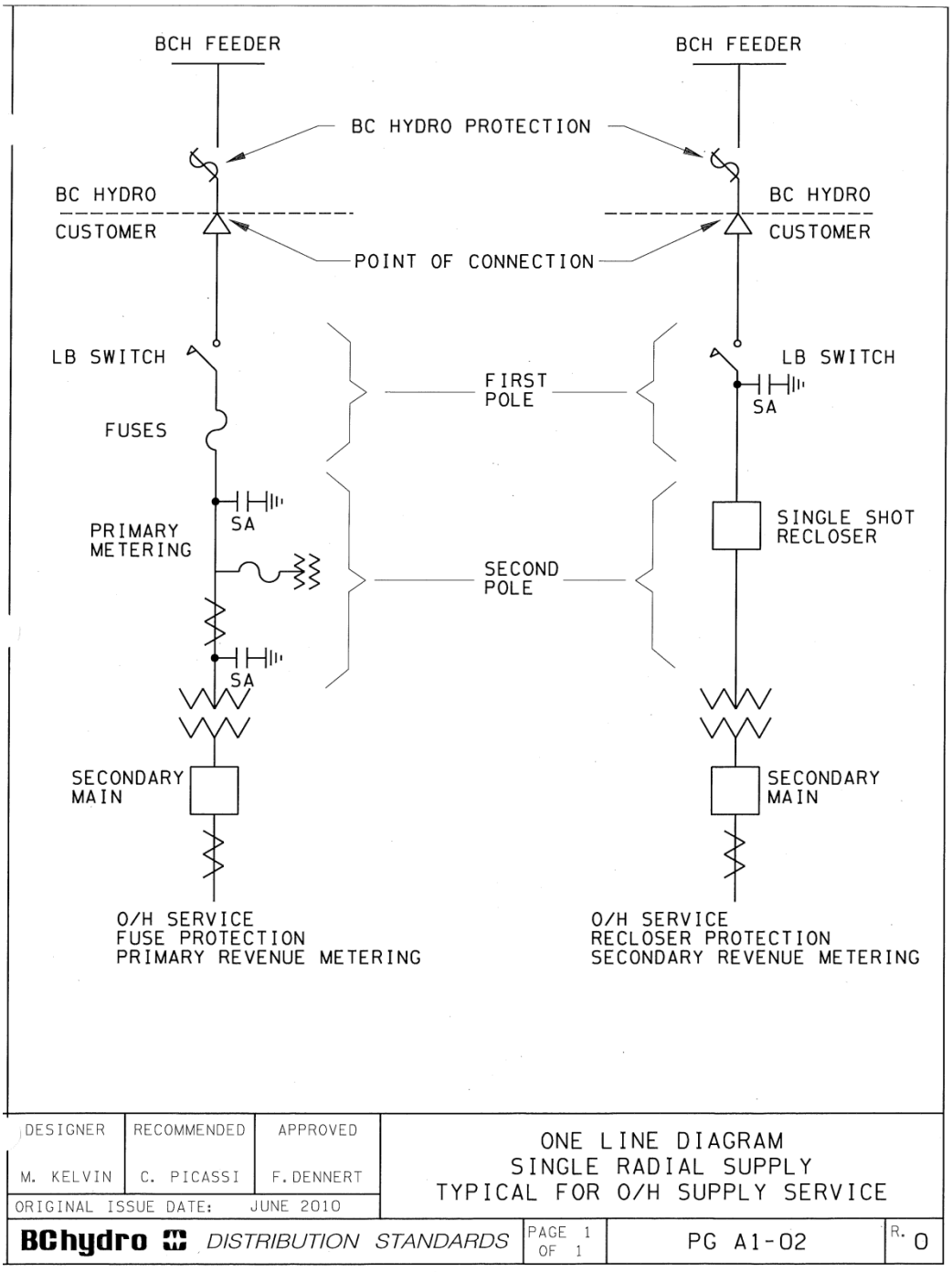
Persons using this manual are responsible for ensuring the following reference documents are the most recent versions.

Appendix Contents

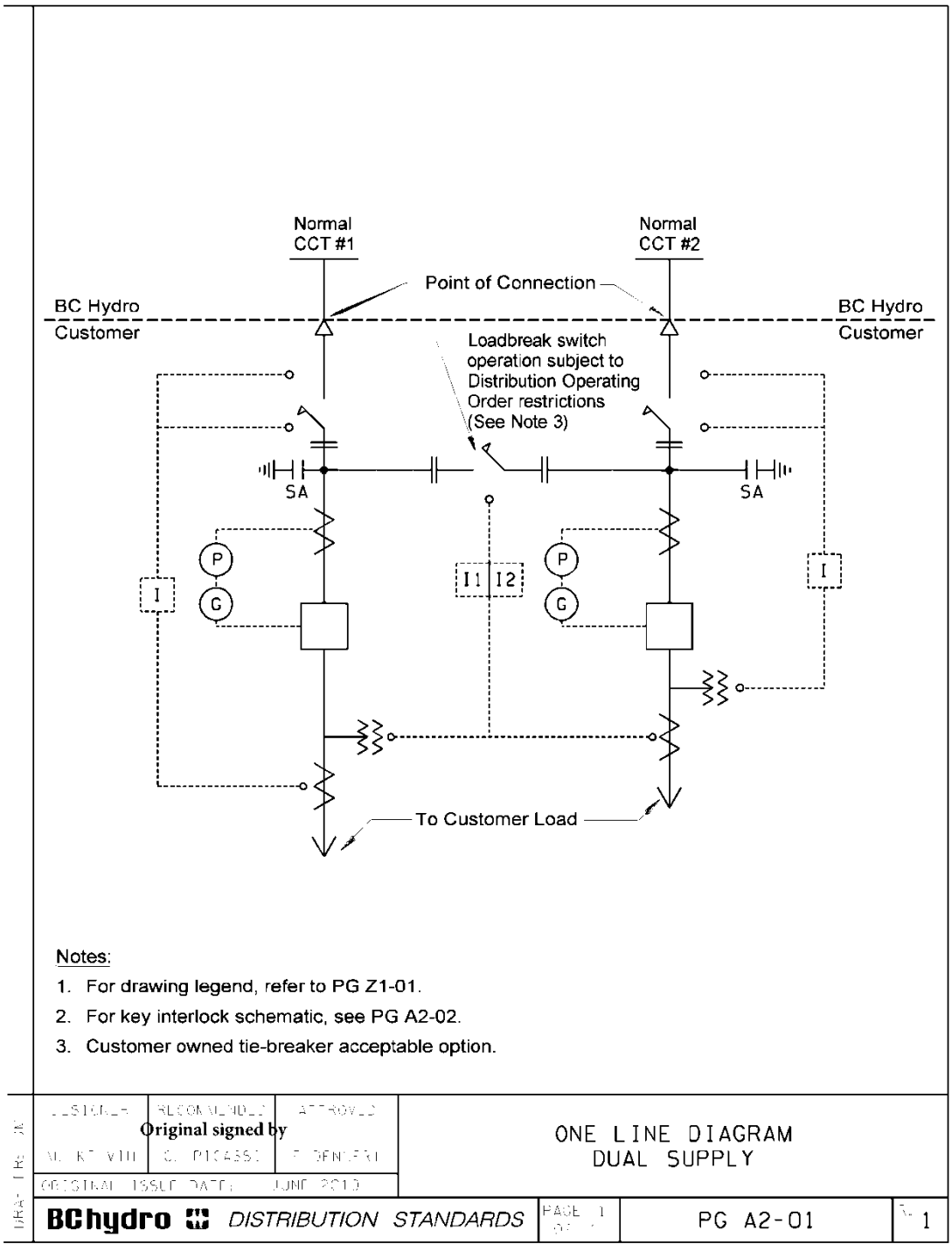
A Electrical Schematics



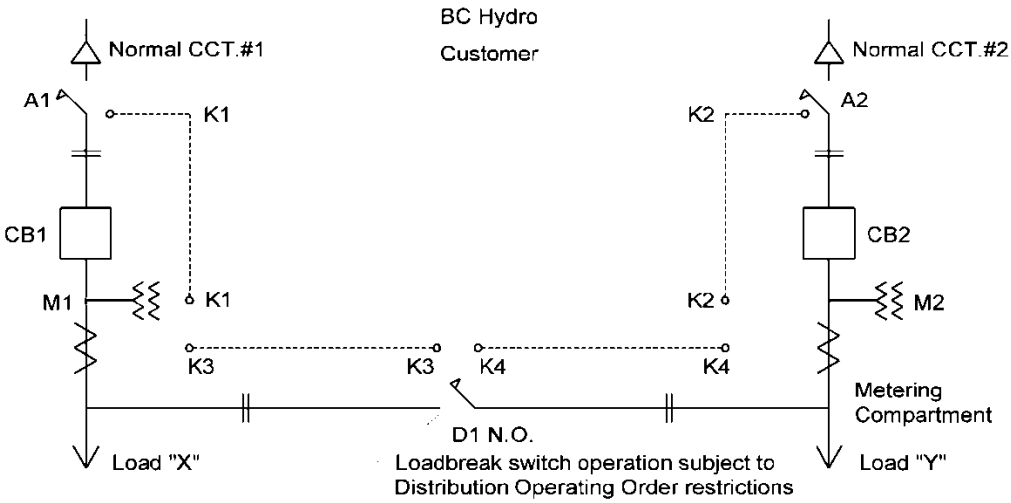
PG A1-01 One Line Diagram Single Radial Supply Typical for U/G Supply Service



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



PG A2-01 One Line Diagram Dual Supply



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.

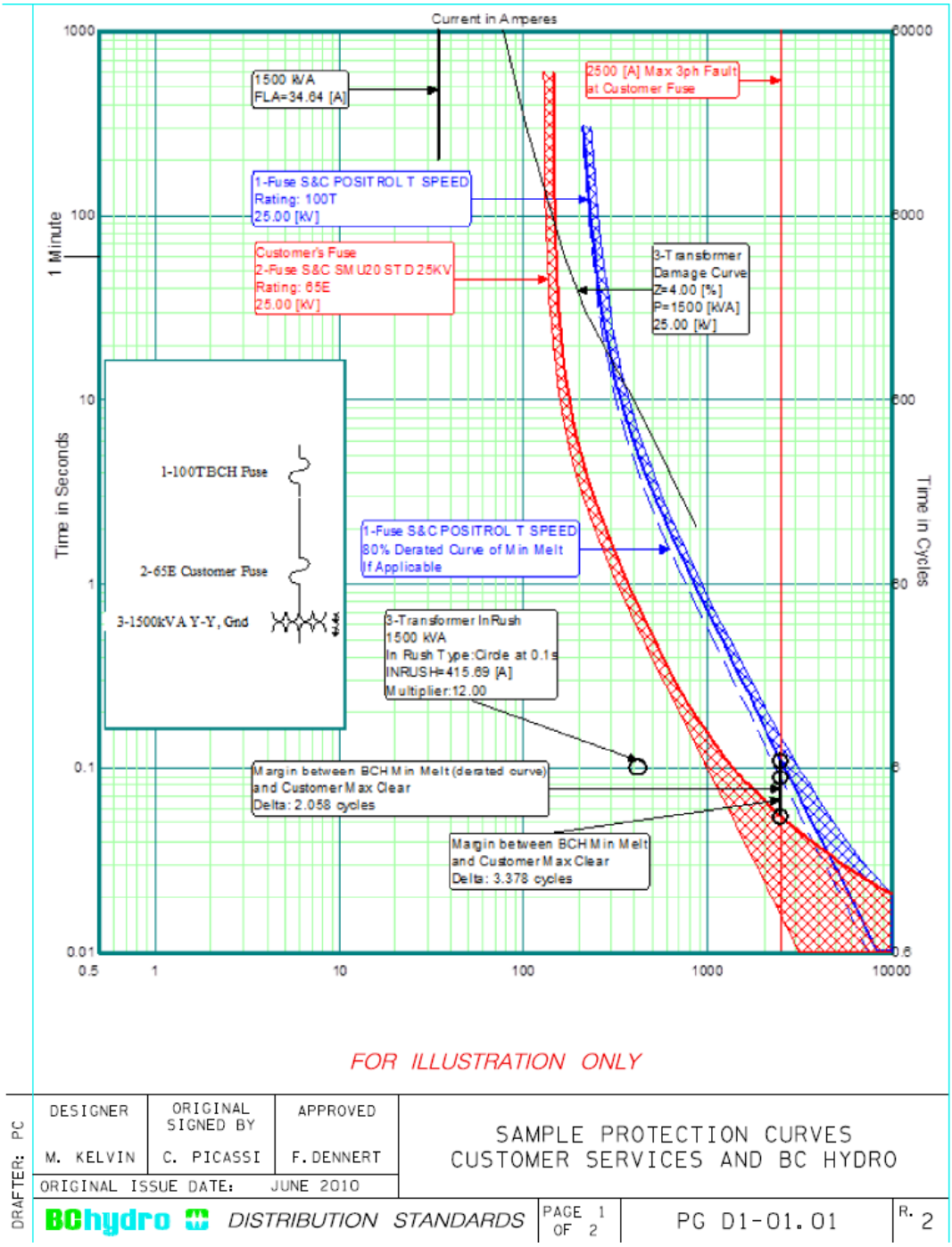
Note:

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.

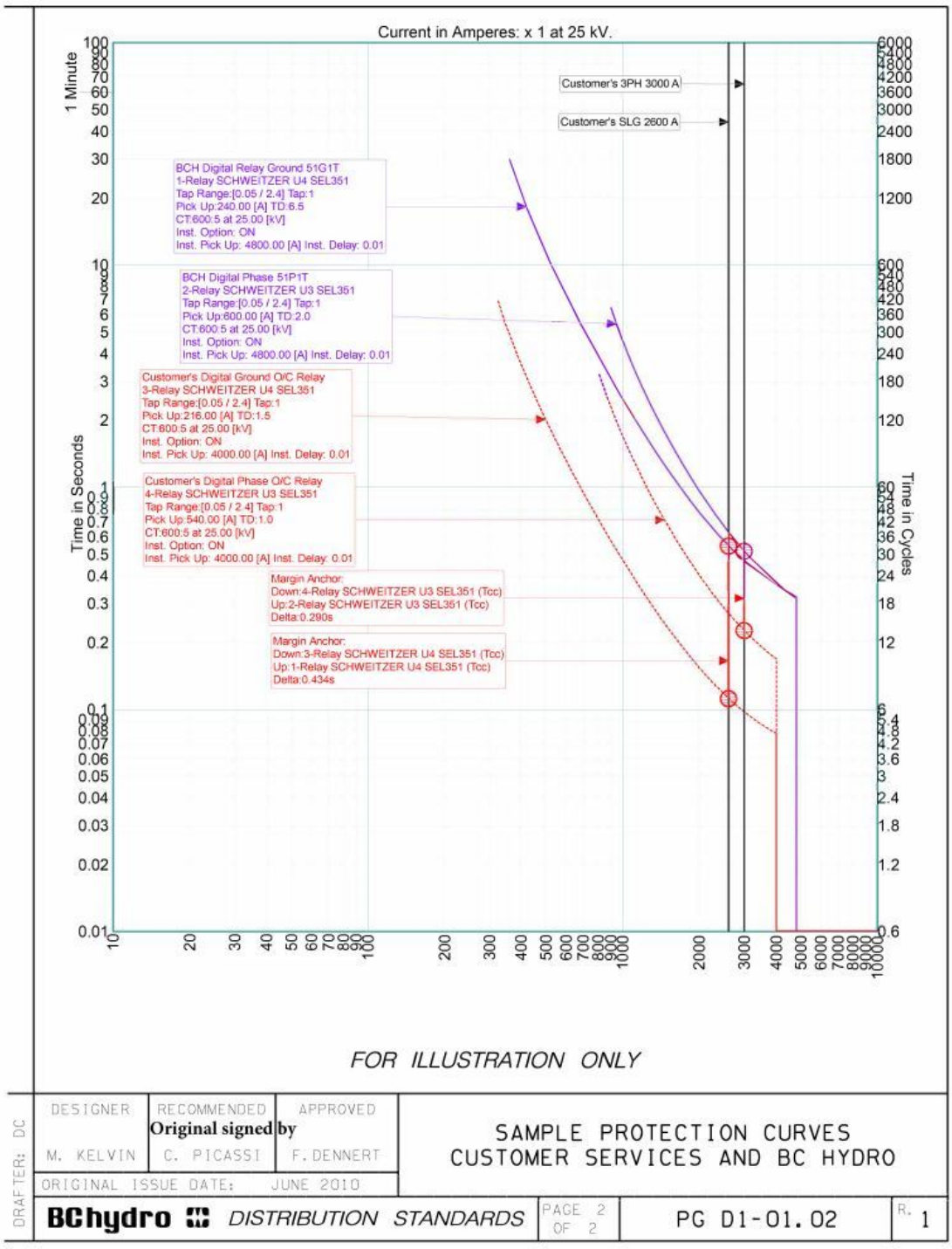
Original signed by		DUAL SUPPLY SERVICE FOUR KEY INTERLOCK	
BC hydro DISTRIBUTION STANDARDS		PG A2-02	1

PG A2-02 Dual Supply Service Four Key Interlock

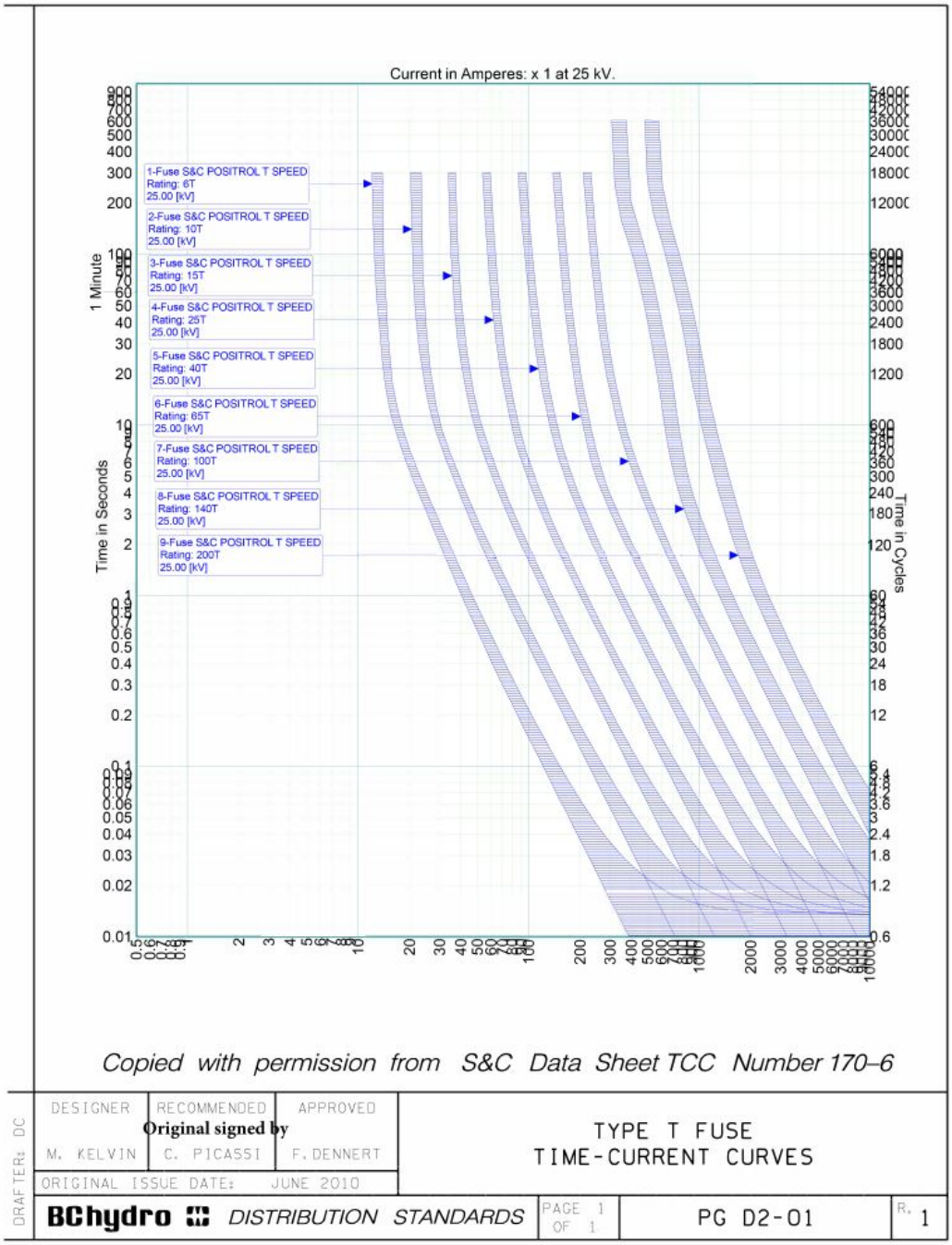
D Protection Coordination



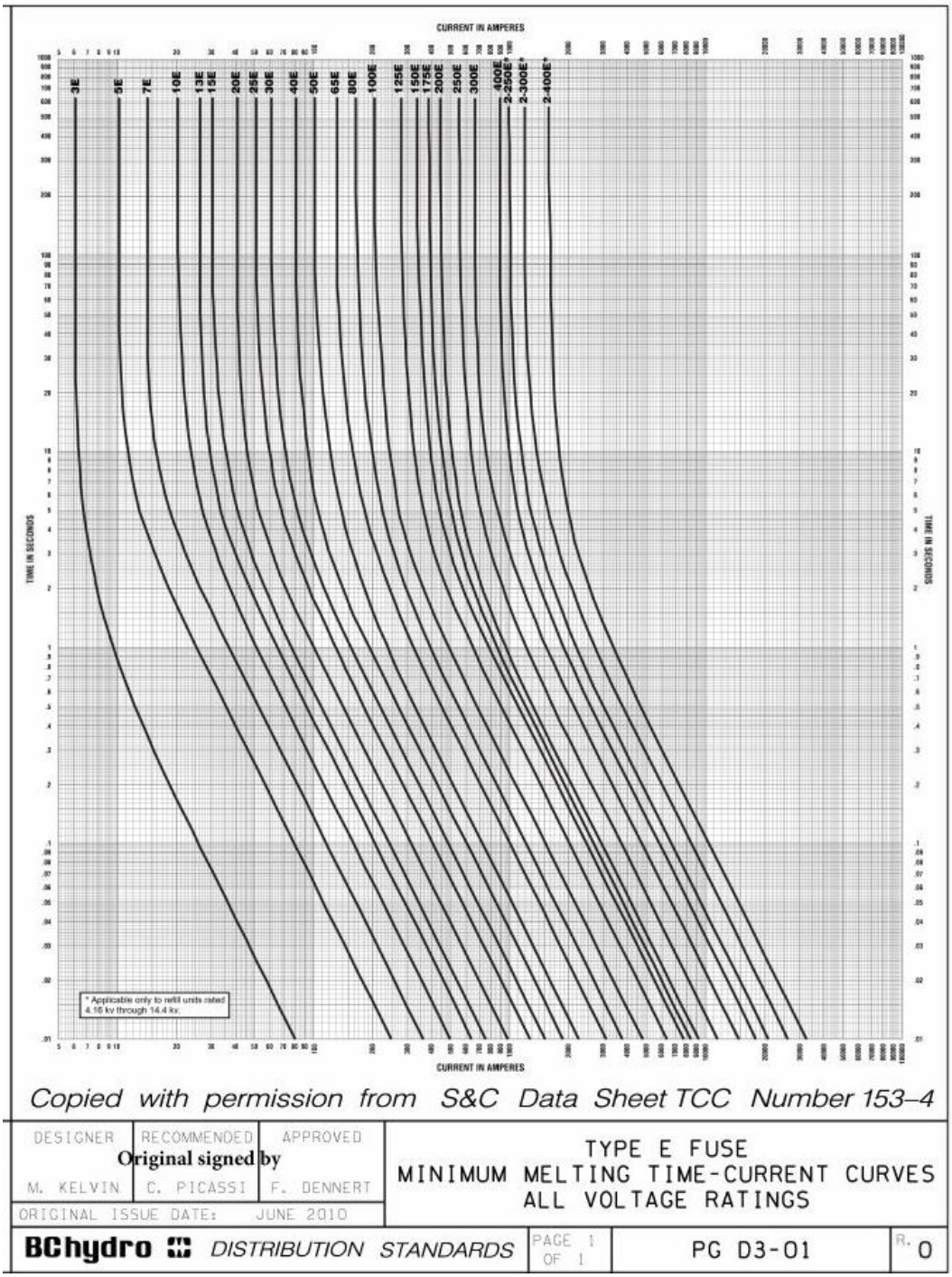
PG D1-01 Sample Protection Curves Customer Services and BC Hydro (page 1 of 2)



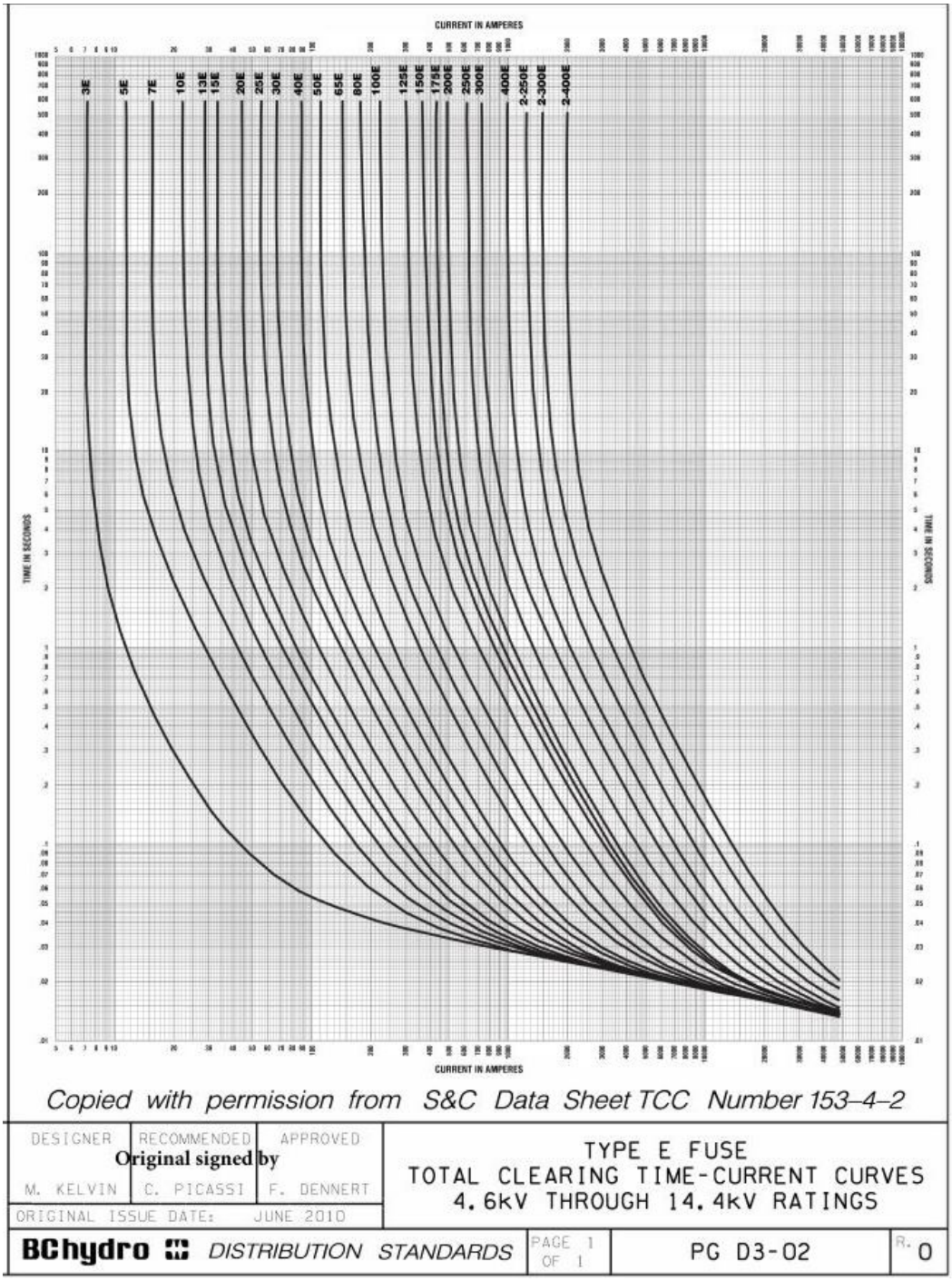
PG D1-01 Sample Protection Curves Customer Services and BC Hydro (page 2 of 2)



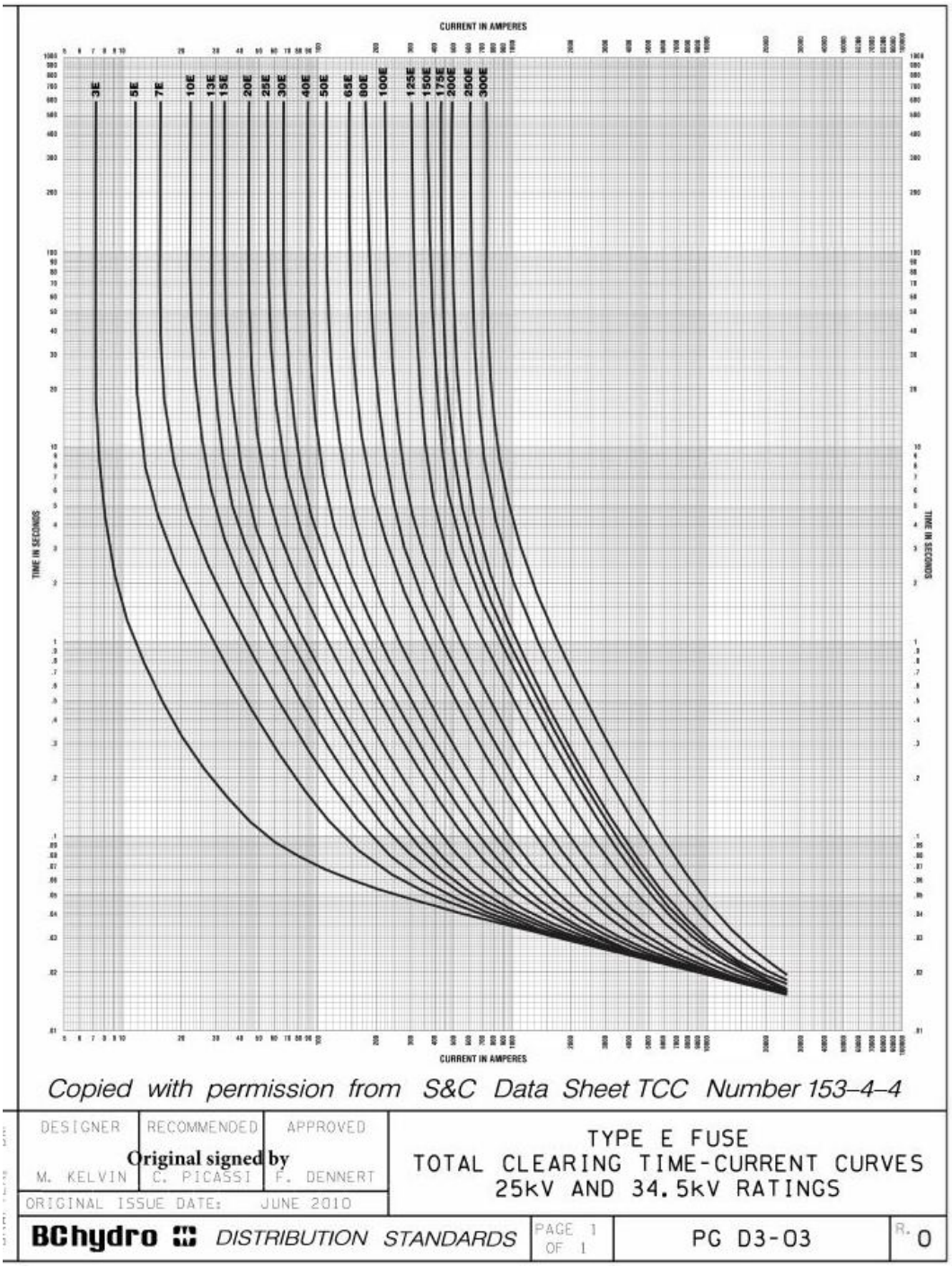
PG D2-01 Type T Fuse Time-Current Curves



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

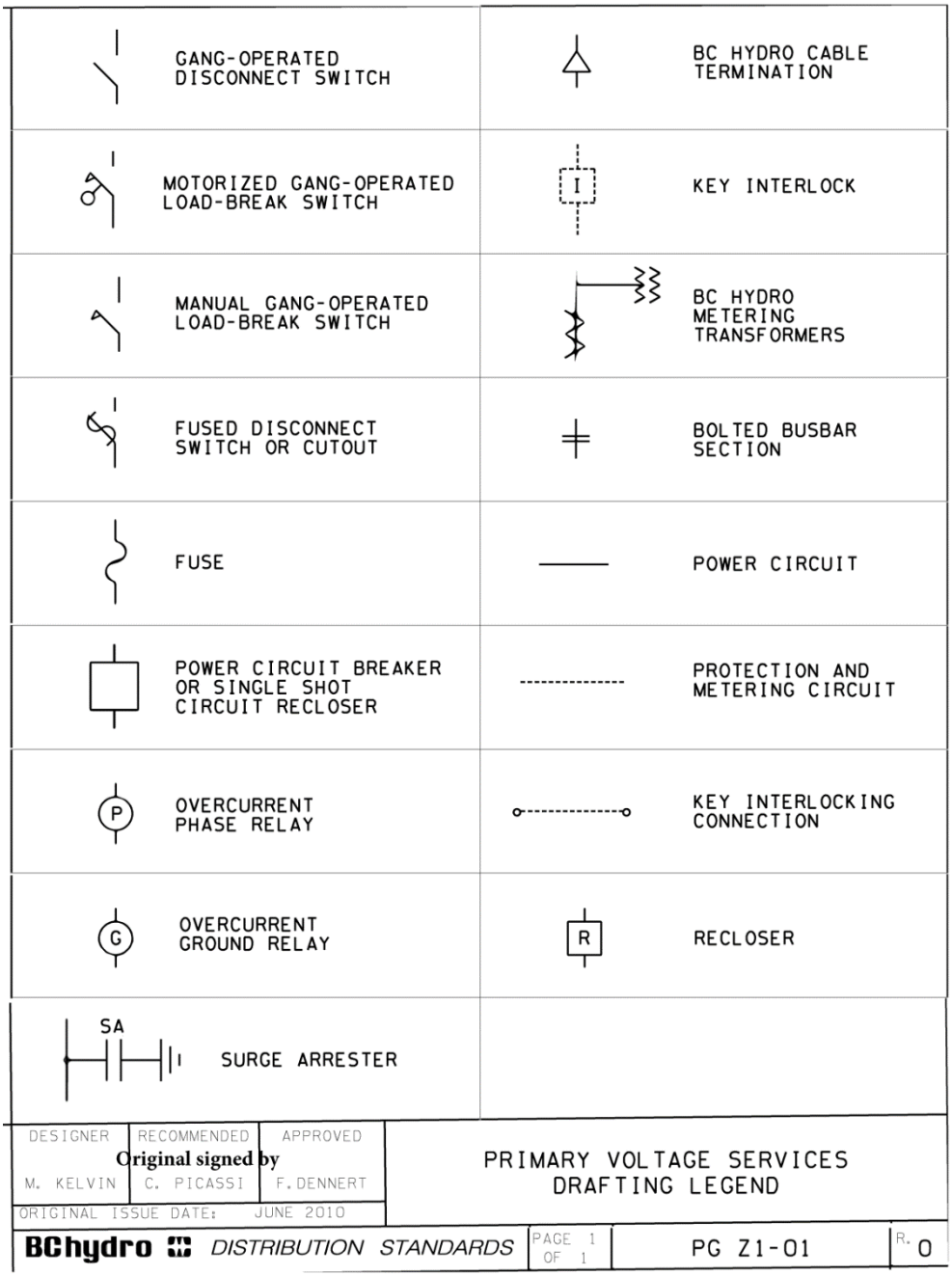


PG D3-02 Type E Fuse Total Clearing Time-Current Curves 4.6 kV and 14.4 kV Ratings



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 and Distribution Standards

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

TSBC HV2018.02 *High Voltage Checklist* (4 pages) (for reference only, not in effect)

BC Hydro Form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment*, revision 11 June 2002 (2 pages)

BC Hydro *Electric Service Agreement*, revision 27 January 2020 (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 Standard ES 64-C-03.06 *Building Vaults on the Dual Radial System* and *Dual Radial Vault Inspection / Maintenance Certification*, revision 1 February 2000 (4 pages)

BC Hydro Standard ES-64-C-03.05 *Building Vaults Inspections and Maintenance*, revision 2, 26 August 2020 (15 pages)

BC Hydro Standard ES43 J7-01 *Primary Revenue Metering Three Phase Four Wire* (4 pages)

BC Hydro Standard ES43 J7-02 *Primary Revenue Metering at Customer's Platform for 7.2/12.5 kV & 14.4/25 kV* (2 pages)

BC Hydro Standard ES43 R3-05 *Bonding and Grounding Equipment Three Phase Primary Metering* (3 pages)

BC Hydro Standard ES43 R3-11 *Bonding and Grounding Equipment List of Components*

BC Hydro Primary Service Cable Marker Plate

Primary Service Connections

- Need a primary distribution voltage service connection (4kv to 35 kv)
- Need a line on private property–not for utility takeover
- Need to reconnect a primary service
- Need to upgrade or alter an existing private line?
- 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 APEGBC 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 As per Tech Feas Review Reqts and 5.2 &5.3 of the Primary Services Guide Pay design deposit	Receive formal acceptance (or partial acceptance pending kiosk/unit-sub/ Switchboard fabrication drawing submittal and acceptance–5.3)	Start electrical construction	Submit fabrication drawings of Primary Service Kiosk or Switchboard, Unit Sub (if these were not already submitted as part of Step 4) As per 5.3 of the Primary Guide	**Step 8** **Switchboard, Sub, Kiosk Fabrication** Order fabrication	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 P.Eng.– stamped as–built 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 Provide you with details of the servicing requirements to be met & deliverables to be submitted back to BC Hydro (5.1.2) 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. 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				**BC Hydro will:** Arrange for BC Hydro Rep attendance/ inspection (eg. Civil Inspector)	**BC Hydro will:** Undertake final inspection We will respond within 4 weeks, either confirming acceptance or providing details of deliverables to be adjusted to energize Build/finalize any ancillary BC Hydro works Energize your service and Start billing	

TECHNICAL SAFETY BC

CHECKLIST – HV2018.02

High Voltage Checklist

Note 1: All items below are to be completed by the permit holder.
Note 2: Checklist is required to be submitted to Technical Safety BC with accompanying documentation prior to service connection.
*Note 3: Checklist items as indicated by * are required by BC Hydro prior to service connection including Asset Holder Operating Permit.*
Note 4: Checklist items not applicable to the installation should be marked N/A in the comments section.
Note 5: Use the Comment section to provide detail and clarity for each of the items.
Note 6: The use of BC Hydro Distribution Standards shall not be used for the design of privately owned equipment unless written authorization from BC Hydro is provided with the plans and specifications.
Note 7: Designers should consult C22.3 NO. 1-15 - Overhead systems, C22.3 NO. 7-15 - Underground systems or other related standards when planning and constructing a privately owned system.
Note 8: Variances are required when the construction of the system deviates from the BC Electrical Code.

Address:		*** Permit #:** Choose an item.
Installation ready for inspection: Click here to enter a date.		*** Operating Permit #:**
System: Choose an item.	**Available Fault Current:**	**Supply Feed Method:** Choose an item.
Primary Volts: Choose an item.	**Primary Fuse Size:** Choose an item.	**Phase:** Choose an item.
Electrical Contractor:		**Licence #:**
Field Safety Representative:		**FSR #:**

✓	Item	Inspection Activity - General Requirments	Reference	Comments
☐	1.	The installation of the electrical equipment listed as part of the permit scope	SSGR, S. 13	
☐	2.	System attributes, such as Volts, Amps, Phases, kVA, etc. installed is the same as listed on the permit.	SSGR S. 13	
☐	3.	* Service equipment is installed in accordance with the utility requirments including ability to be locked out and isolated	36-200	
☐	4.	Plans and Specifications, design stage, signed and stamped by Professional Engineer have been submitted.	2-014	
☐	5.	* "As built or as constructed" engineering drawings have been submitted to the utility, equipment owner named on the operating permit.	2-014	

TSBC HV2018.02 *High Voltage Checklist* (page 1 of 4)

Note: For reference only, not in effect

TECHNICAL SAFETY BC

CHECKLIST – HV2018.02

☐	6.	Verify that installation has been made in accordance with the manufacturer's installation instructions including labeling of materials and equipment.	2-100, 12-012	
☐	7.	Complete assemblies are approved for their use; Wire, cable, and component parts are either approved or have been accepted by Professional Engineer with documentation.	2-024, Directive	
☐		All fire stop partitions installed, all cables and raceways flame spread rated.	2-128, 2-130, 2-132	
☐		Equipment location, secure mounting and adequate ventilation space for equipment provided.	2-114, 2-116, 2-122, 2-126, 2-320, 26-004, 26-008	
☐		Lighting, including emergency lighting and exits are provided.	2-316, 46-300, 46-400	
☐		Non-combustible hoods and shields are installed on equipment in sprinklered rooms.	26-008	
☐		Working space with secure footing is provided and maintained around electrical equipment including pole-mounted switches, out equipment, vaults and electrical rooms.	2-308	
☐		Entrance to and exiting from working space including junction boxes, pull pits, cable terminations and fuse compartments has unobstructed means of egress	2-310	
☐		Broken or damaged parts and contamination by foreign materials not present.	2-124	
☐		Unused openings in equipment have been effectively closed.	12-3002	
☐				
☐		Overhead clearances to energized equipment are maintained and exposed conductors are supported, spaced and guarded by elevation or suitable barriers.	36-106, 36-108, 36-110, 36-212	
☐		Underground conductor ampacities are calculated in accordance with IEEE 835.	4-004	
☐		Underground cables and ducts are spaced as required to meet the ampacities calculated.	4-004	
☐		Underground conduits including pull pits are adequately drained by means of fittings, control pumps, etc.	6-300	

TSBC HV2018.02 *High Voltage Checklist* (page 2 of 4)

Note: For reference only, not in effect

TECHNICAL SAFETY BC

CHECKLIST – HV2018.02

☐		Underground raceways are provided with seals when entering the building.	6-300	
☐		Dielectric-filled equipment installed indoors is installed in a vault, service room, electrical room or provided with containment as permitted.	26-012, 26-246	
☐		Dielectric-filled equipment installed outdoors has the necessary containment, and is located in an acceptable location with barriers or fencing.	26-014	
☐		Transformers located outdoors are away from combustible surfaces, material, doors, windows, or ventilation openings.	26-240, 26-242, 26-244	
☐		Over-current protection is properly sized for each transformer.	26-252	
☐		Poles, cross-arms, brackets, insulators, guys and anchors, secured and supported with clearances as required.	2-024, C22.3 No. 1-18	
Grounding and Bonding				
☐		Grounding completed as per engineered design with approved modifications and revisions (final state tested with results provided)	36-304	
☐		Station ground electrode(s) installed	36-302	
☐		Copper conductors are used for grounding and bonding as required.	36-300	
☐		All metal structures, equipment, and items forming part of a station are grounded.	36-308	
☐		Switch handle and gradient control mat installed, level surface, accessible, and grounded to station ground in 2 locations.	36-310	
☐		Exposed metal in vaults bonded to ground.	36-308	
☐		Unit substation enclosure bonded to ground.	36-308	
☐		Metallic fencing, gates, posts installed inside of the station ground and bonded to station ground.	36-312	
Markings				
☐		Warnings and cautions marked on all entrances, equipment locations, etc.	2-102, 36-006	
☐		One-Line Drawing posted.	36-006	
☐		Cables, cable trays, marked every 10 Meters.	36-006	

TSBC HV2018.02 *High Voltage Checklist* (page 3 of 4)

Note: For reference only, not in effect

TECHNICAL SAFETY BC

CHECKLIST – HV2018.02

☐		Station fencing marked.	36-006	
☐		Concrete concealed conductors and cables are marked every 3 Meters.	36-100(3)	
☐				
☐				
Tests and Studies (* denotes requirement for BC Hydro as well) All reports must be complaint and reports with unacceptable results shall not be submitted				
☐		* Ground Potential Rise, step and touch grounding report.	36-304	
☐		* Fault current coordination study.	36-204, 36-204	
☐		* Protective relaying study and confirmation of setting.	36-206	
☐		* Service switch or breaker test report.	36-200	
☐		* Protective relaying test report.	36-202	
☐		* Transformer production and commissioning test report for unitized substations, including an oil analysis report		
☐		* High voltage cable test report for service connections involving customer installed cables if applicable.		

References:
BC Electrical Code under adoption
Directive, Exemptions to Public Utilities; https://www.technicalsafetybc.ca/alerts/exemptions-public-utilities
Bulletin, Exemptions to Public Utilities; https://www.technicalsafetybc.ca/alerts/electrical-safety-regulation-application-public-utilities
Directive, High Voltage Installations; https://www.technicalsafetybc.ca/alerts/high-voltage-installations
Bulletin, High Voltage installations; https://www.technicalsafetybc.ca/alerts/high-voltage-installations-0
Directive, Electrical Operating Permit; https://www.technicalsafetybc.ca/alerts/directive-electrical-operating-permit-requirements
Bulletin, Operating Permits; https://www.technicalsafetybc.ca/alerts/operating-permits
Bulletin, Overhead Lines Guidelines; https://www.technicalsafetybc.ca/alerts/overhead-lines-guideline
Bulletin, Approved Certification Marks; https://www.technicalsafetybc.ca/alerts/approved-certification-marks-electrical-products
CSA Standards; C22.3 NO. 1-15 - Overhead systems, C22.3 NO. 7-15 - Underground systems

BC Hydro Primary Guide for Customer Owned Primary Services; https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/distribution/standards/ds-primary-guide-2010-4kV-to-35kV.pdf

☐ Checking this box and submitting this form to Technical Safety BC via email constitutes your authorization. This has the same effect as submitting a handwritten signature.

Applicant Signature: _____ Date: _____

Page 4 | 4

TSBC HV2018.02 *High Voltage Checklist* (page 4 of 4)

Note: For reference only, not in effect

Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment

BC Hydro

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 judgment, the Equipment is not compatible with or suitable for the BC Hydro electrical system.

The judgment 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 _____

Transformers:

Bank kV•A	H.V. Winding				L.V. Winding				High Voltage Taps				On-load Tap Changer ± ____ %	Impedance % ____ on bank kV•A base (ONAN)
	Volts	Δ	Y	Y Grounded	Volts	Δ	Y	Y Grounded	Above Rated Volt. No.	Above Rated Volt. %	Below Rated Volt. No.	Below Rated Volt. %		

Service Entrance: (Complete I or II)

(I) Circuit Breaker:

Voltage Rating kV	Current Rating Amps	Interrupting Rating KA SYM RMS	Clearing Time Cycles	Trip Coil - Current Trip Amps (ac) - or Shunt Trip Volts (dc)

(II) Fuse Protection: **Either Load Break Switch, or Disconnect Switch Interlocked with Secondary Breaker.**

(A) Switch (Specify Mounting): Pole ☐ Structure ☐ Cubicle ☐

Voltage Rating kV	Load Interrupting Rating Amps	At % P.F.	Momentary Rating Amps	At % P.F.	Manufacturer (if known)	CSA Approval Yes ☐ No. ☐

(B) Fusing

Manufacturer	Manufacturer Type Designation	Rated Continuous Current	Rated Maximum Voltage	Fuse Characteristics

Interconnection Protection:

Protection	Manufacturer	Type/Style	Timed Element Setting Range	Inst. Element Setting Range
Ground Overcurrent				
Phase Overcurrent				
☐ Over ☐ Under Voltage				
☐ Over ☐ Under Frequency				
Synchronizing Check				
Reverse Power				
Differential				
Under Frequency Load Shedding				

Are C.T.'s adequate to operate relays and current trip coils where applicable for all current magnitude from minimum trip to maximum fault duty?

☐ Yes ☐ No based on maximum fault duty of _____ MV•A

Last revised: 11 June 2002
td-stateprimvoltequip.doc

Sheet 1 of 2

BC Hydro Form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment*, revision 11 June 2002 (page 1 of 2)

Metering:

			Estimated Maximum Demand		Metered Voltage
Pole Metering.	Yes ☐	No ☐	Initial	Future	
Vault or Indoor Unit Sub.	Yes ☐	No ☐			Rate Schedule
Outdoor or Unit Sub	Yes ☐	No ☐	_____ kW	_____ kW	

Customer Generation:

☐ No Customer generation.
☐ Customer generation not parallel to BC Hydro supply, transfer switch type: _____
☐ Customer generation parallel to BC Hydro supply but with no agreement to sell electricity to BC Hydro.
☐ Customer generation parallel to BC Hydro supply with intent to sell electricity to BC. Hydro.

} If selected, complete Generators Section.

Generators:

Type	Energy Source	Manufacturer	Rated Output in kW	Rated Output Voltage	Power Factor	3 PH or 1 PH	Total Harmonic Content Current	Total Harmonic Content Voltage	Reactance in % Machine kV•A Base Xd	Xd'	Xd''	Machine Inertia Constant H

1. Synchronous Generator 2. Induction Generator 3. Other: _____

1. Hydraulic 2. Gas 3. Woodwaste 4. Diesel 5. Other: _____

If the above space is insufficient for all generators, please provide remaining generator information separately.

Seal of Professional Engineer

	BC Hydro
Company	
Signature	Received By
Date	Date

Last revised: 11 June 2002
td-stateprimvoltequip.doc

Sheet 2 of 2

BC Hydro Form *Statement to BC Hydro Regarding Primary Voltage Service Entrance Equipment*, revision 11 June 2002 (page 2 of 2)

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.

elecsvcagmt.doc Last revised: January 27, 2020

BC Hydro *Electric Service Agreement*, revision 27 January 2020 (page 1 of 2)

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.

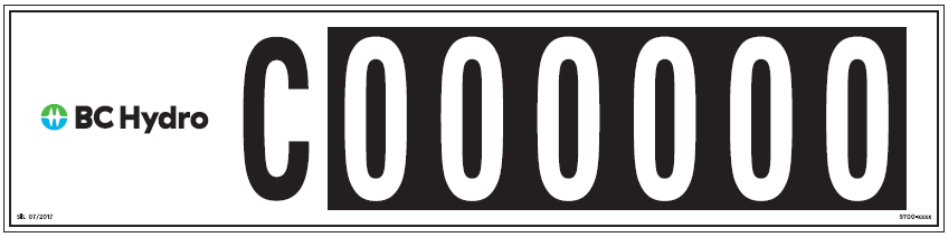
Electric Service Agreement

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

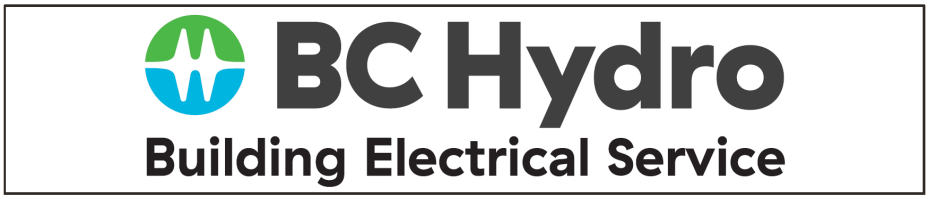
elecsvcagmt.doc Last revised: January 27, 2020

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

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)

Appendix B (extract from)

BC HYDRO DISTRIBUTION INSPECTION & MAINTENANCE STANDARD
ES 64-C-03.06 Date 01 FEB 2000

BUILDING VAULTS ON THE DUAL RADIAL SYSTEM

1.0 INTRODUCTION

An inspection and maintenance program is essential to assure the integrity of BC Hydro equipment installed in vaults located in customer buildings, for the safety of BC Hydro personnel and effective system operation. Ongoing and Annual inspection of the equipment is necessary to monitor its condition and provide a report that will specify the remedial action needed to correct deficiencies.

2.0 PURPOSE

This standard outlines minimum inspection and maintenance procedures for BC Hydro owned equipment located in building vaults to provide safe and reliable operation. This standard is to aid and supplement, but not replace the manufacturer's recommended maintenance standard.

3.0 POLICY

Building vaults containing BC Hydro equipment shall be inspected annually while energized and maintenance work performed on a priority system. In an addition, an overhaul of the equipment shall be performed every three years with the vault de-energized. All work shall be performed in accordance with BC Hydro approved safety practices and regulations. All work shall be performed by qualified and authorized workers or contractors. All aspects of inspections and maintenance work performed will be recorded on forms shown on pages 5 through 16

4.0 ONGOING INSPECTION AND ASSESSMENT PROCEDURE

Assessment of vaults are encouraged and completed when B C Hydro employees are performing switching tasks on the dual radial system. A summary Inspection sheet (see Appendix A, page 5) will be filled out whenever remedial action is deemed necessary by employees and/or managers. A copy of the summary Inspection sheet will be used to communicate and follow up deficiencies with customers. The maintenance work to be done will be identified according to the following priority system:

PRIORITY 1

IMMINENT risk items where the work must be reported immediately to BC Hydro's manager and arrangements made to complete this work within 7 days.

PRIORITY 2

URGENT risk items where work must be reported to BC Hydro's manager within 5 days and arrangements made for this work to be completed within 60 days.

PRIORITY 3

ROUTINE risk items, where the work is reported to BC Hydro's manager within 5 days and arrangements made to complete the work within 12 months.

BC Hydro Standard ES 64-C-03.06 *Building Vaults on the Dual Radial System* and *Dual Radial Vault Inspection / Maintenance Certification*, 1 February 2000 (page 1 of 4)

5.0 ANNUAL INSPECTION AND MAINTENANCE PROCEDURE

An annual inspection of dual radial vaults is also necessary. See Appendix B1 and B2, (annual Inspection sheets, pages 6 & 7). A check list inspection system details the specific items to be inspected, the conditions expected, and a results table that identifies maintenance work to be done according to the priority system of section 4.

6.0 ANNUAL INSPECTION AND MAINTENANCE DECAL

Post an inspection/maintenance DECAL adjacent to the switch viewing window. The decal shall measure 2 inches high by 3 inches wide and contain the following;

- inspection date
- next inspection due date
- inspection Company's name
- inspector's name
- previous 3 year maintenance/overhaul date
- vault I D

7.0 MAINTENANCE PROCEDURE EVERY THREE YEARS.

A complete overhaul of BC Hydro owned equipment shall be performed at three year intervals with the equipment de-energized. The checklists on pages 5,through 16, detail the specific items to be maintained. The three year maintenance shall be coordinated to include maintenance work identified in the annual inspection.

8.0 DOCUMENTATION

- all inspection reports will be signed by the inspector of the company performing the work.
- maintenance items requiring additional work will be identified, reported to the BC Hydro manager and prioritized as noted in section 4.
- A duplicate copy of the inspection report shall be placed in a transparent plastic pouch in a conspicuous location inside the vault.
- Where the vault access description has changed, an updated copy of the page 3 vault information shall be placed in the pouch

9.0 RECORDS

A file shall be established for each building vault and contain the information shown on page 3 (vault I D # , address, circuit #, location guide etc.).

Appendix C

- 3 -

BC Hydro Standard ES 64-C-03.06 *Building Vaults on the Dual Radial System* and *Dual Radial Vault Inspection / Maintenance Certification*, 1 February 2000 (page 2 of 4)

Dual Radial Vault Inspection/Maintenance Certification

Vault number	**Property Owner** Name _____ Phone _____	
Building Address	**Property Manager** Name _____ Phone _____	
Date of Last Inspection Completed by	**Contact for Access (24hrs/day)** Name _____ Phone _____ Pager _____	
Date of Last Maintenance/Overhaul Completed by	Running Circuit Completed Date:	Standby Circuit Completed Date:
Date of next planned maintenance		

Signed: _____ Date: _____

Print name: _____

Once complete please fax to: **Bruce Miller**
Project Manager
Dual Radial Vault Maintenance
528-2771

BC Hydro Standard ES 64-C-03.06 *Building Vaults on the Dual Radial System* and *Dual Radial Vault Inspection / Maintenance Certification*, 1 February 2000 (page 3 of 4)

Dual **R**adial **V**ault **I**nspection/**M**aintenance **C**ertification

Vault number	Property owner name and phone
Building address	Property manager name and phone
Date of last inspection Completed by Phone	Contact person for access (24 hrs/day)
Running circuit: Date: Worker: Company: Maintenance due	Standby circuit: Date: Worker: Company: Maintenance due

Operations centre tel: (604) 528 2900 or
drvsupport@bchydro.com

BC Hydro

BCH17-312

BC Hydro Standard ES 64-C-03.06 *Building Vaults on the Dual Radial System* and *Dual Radial Vault Inspection / Maintenance Certification* (page 4 of 4)

BC Hydro	Distribution Maintenance Standard	
Subject: BUILDING VAULT INSPECTIONS AND MAINTENANCE	**Number:**	ES-64-C-03.05
	Prepared by:	D.G. Tarampi
	Issued by:	E.J. Mah
	Revision:	2
	Date: August 26, 2020	**Page** 1 of 15

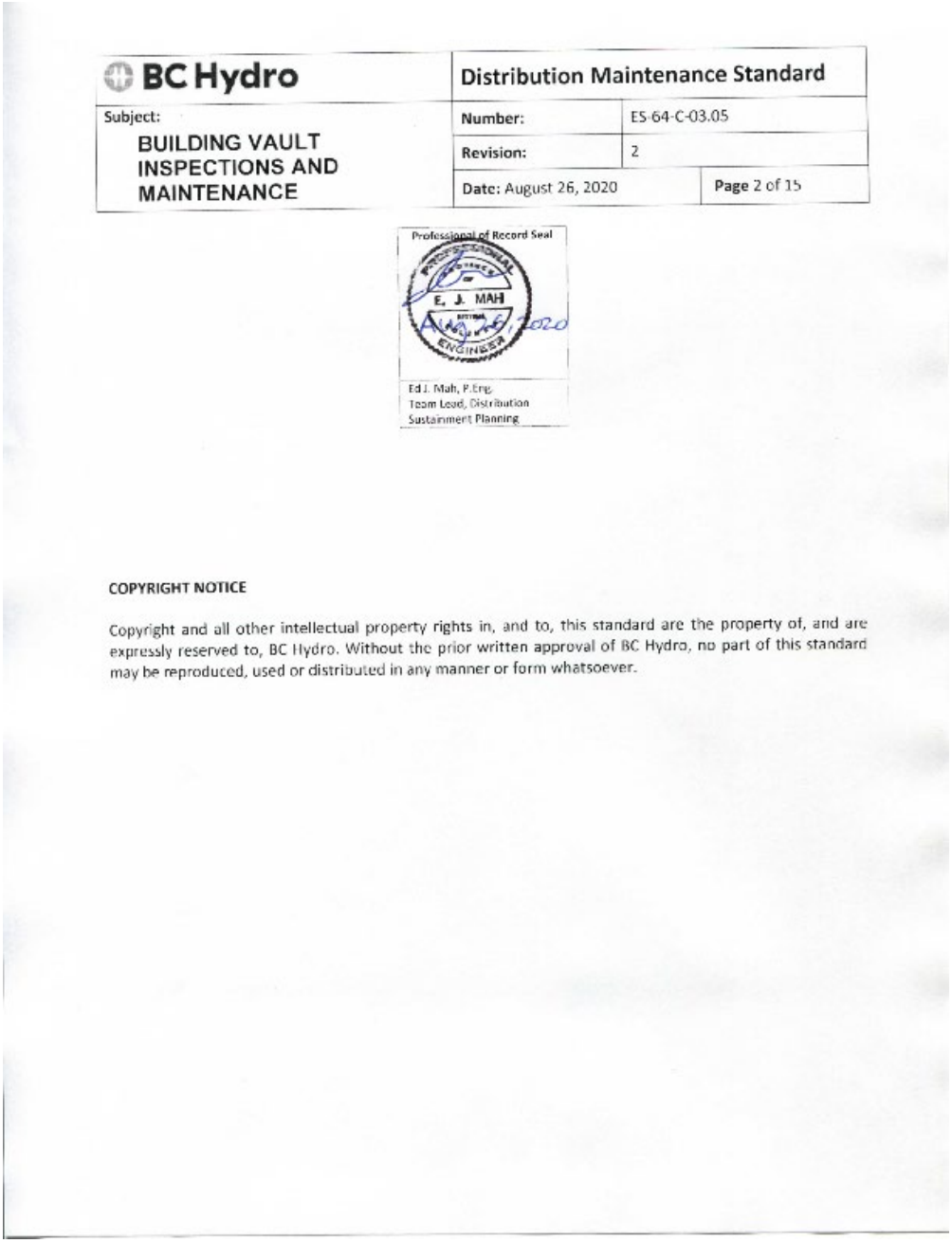
TABLE OF CONTENTS

This document is due for review in 2025.

Revision	Description	Prepared By	Approved By	Date
2	Complete Rewrite	D.G.Tarampi	E.J.Mah	26-Aug-2020
1	Review/Reformat	Wal Shum	Wal Shum	Nov-2000
0	Initial Issue	J.C. Hayek	DSC	Nov-1991

Printed Copies are Uncontrolled

BC Hydro Standard ES-64-C-03.05 *Building Vault Inspections and Maintenance*, revision 2, 26 August 2020 (page 1 of 15)



BC Hydro | Distribution Maintenance Standard

Subject: BUILDING VAULT INSPECTIONS AND MAINTENANCE

Number: ES-64-C-03.05

Revision: 2

Date: August 26, 2020 Page 2 of 15

Professional of Record Seal

E. J. MAH

ENGINEER

Ed J. Mah, P.Eng.
Team Lead, Distribution
Sustainment Planning

COPYRIGHT NOTICE

Copyright and all other intellectual property rights in, and to, this standard are the property of, and are expressly reserved to, BC Hydro. Without the prior written approval of BC Hydro, no part of this standard may be reproduced, used or distributed in any manner or form whatsoever.

BC Hydro Standard ES-64-C-03.05 *Building Vault Inspections and Maintenance*, revision 2, 26 August 2020 (page 2 of 15)

BC Hydro	Distribution Maintenance Standard	
Subject: BUILDING VAULT INSPECTIONS AND MAINTENANCE	**Number:**	ES-64-C-03.05
	Revision:	2
	Date: August 26, 2020	**Page** 3 of 15

1 INTRODUCTION

A regular maintenance program is essential in assuring the integrity of distribution equipment installed in vaults located within customer owned buildings.

Since 2011, BC Hydro has standardized the underground primary voltage connections to customers in either Single Radial or Dual Supply configurations. These two supply configurations require the customers to own and maintain all of the distribution equipment located downstream of the Point of Connection (POC) inside the building vault. Previously available Dual Radial and Primary Loop Supply configurations are no longer provided for new construction.

2 SCOPE AND PURPOSE

This Standard outlines minimum preventive maintenance inspection and maintenance procedures for equipment owned by BC Hydro and /or equipment owned by customers but require to be operated by BC Hydro installed in vaults located in customer buildings. This standard covers the maintenance requirements for medium voltage equipment in the following vaults:

- Single Radial vault
- Dual Supply vault
- Dual Radial vault
- Primary Loop vault

The inspection procedures below ensure the integrity of the distribution equipment and provide safe and reliable operation. This standard adds to but does not replace the equipment manufacturer's recommended maintenance standard.

Customer equipment installed outside of the buildings such as pad mounted switchgear or transformers are not part of this standard as this type of equipment is owned and maintained by customers.

3 REFERENCES

This standard shall be read in conjunction with other Distribution Maintenance Standards including the following:

- Standard ES-64-C-01.05 Manhole Inspections and Maintenance
- Standard ES-64-C-01.09 Infrared Thermography Vaults & Padmounts
- Standard ES 64-C-03.07 Underground Switchgear Inspections and Maintenance

This standard shall also be read in conjunction with various Distribution Underground Safe Work procedures.

BC Hydro	Distribution Maintenance Standard	
Subject: BUILDING VAULT INSPECTIONS AND MAINTENANCE	**Number:**	ES-64-C-03.05
	Revision:	2
	Date: August 26, 2020	**Page** 4 of 15

4 POLICY

Building vaults containing BC Hydro equipment shall be inspected and maintained by BC Hydro every three (3) years with the vault de-energized. All aspects of inspections and maintenance work shall be performed in accordance to the applicable checklists in Appendix B.

Other than switches in Dual Radial and Dual Supply vaults, it is recommended that building vaults that do not contain BC Hydro equipment be inspected and maintained by the Customer as per CSA requirements and manufacturer's recommendations.

For the Dual Radial and Dual Supply vaults, switches are under the operating authority of BC Hydro. Although they are customer owned, only BC Hydro personnel are permitted to carry out routine and emergency switching of these Dual Radial and Dual supply switches. It is therefore essential to assure the integrity that these switches are safe and reliable to operate. A complete overhaul and maintenance of these switches must be completed by the customer at three years intervals with the vault de-energized. An electrical worker qualified to work on high voltage equipment is required to perform the maintenance work. The minimum work performed shall be include the items on "Inspection and Maintenance Checklist - Customer Owned Switchgear Operated by BC Hydro" found in Appendix B.

When BC Hydro crews attend a customer owned vault (e.g. dual radial or dual supply) to do some routine switching, the crews should complete "Inspection and Maintenance Checklist - Customer Owned Switchgear Operated by BC Hydro" found in Appendix B. A copy of the checklist shall be used to communicate and follow up deficiencies with customers.

5 TROUBLE AND SPILL RESPONSE

Hazards identified which require immediate action shall be reported to the Distribution Restoration Centre at 1-888-Poweron.

For active oil leaks identified during inspections, follow BC Hydro Spill Response procedures to ensure spills are addressed appropriately.

6 QUALIFICATIONS

Building Vaults often contain exposed electrical components operated at 12.5 and 25 kV. All workers performing these inspections shall be qualified to perform this work.

7 QUALITY MANAGEMENT PLAN

A quality management plan shall be submitted and to be accepted by BC Hydro prior to proceeding with any work.

BC Hydro	Distribution Maintenance Standard	
Subject: BUILDING VAULT INSPECTIONS AND MAINTENANCE	**Number:**	ES-64-C-03.05
	Revision:	2
	Date: August 26, 2020	**Page** 5 of 15

8 SAFE WORK PRACTICES AND REGULATIONS

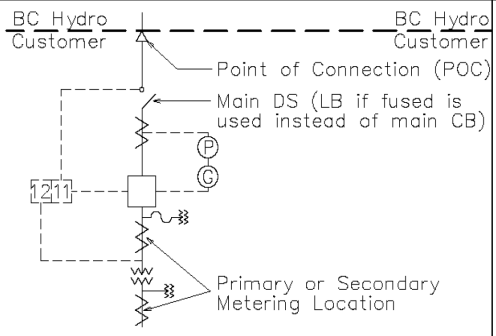
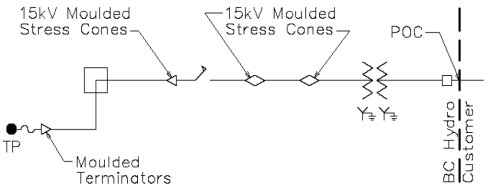
This Standard is not a work procedure. This standard must be read in conjunction with any applicable Confined Space entry procedures, procedures related to the presence of Asbestos Materials and procedures related to Arc Flash hazards.

Safety Practices Regulations and Local Operating Orders must be followed where applicable. Special precautions are necessary before and during the inspection of and maintenance work conducted in the equipment. The procedures described in relevant and current Occupational Safety and Health (OSH) Standards must be adhered to.

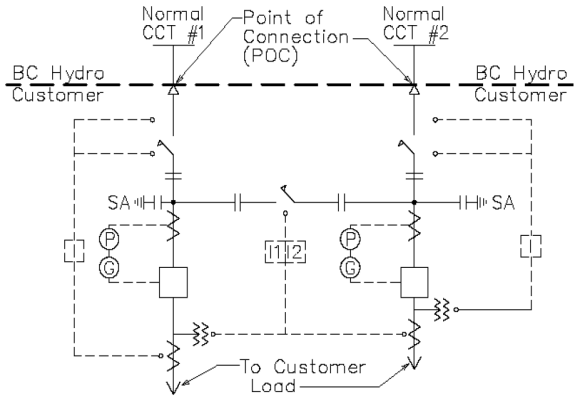
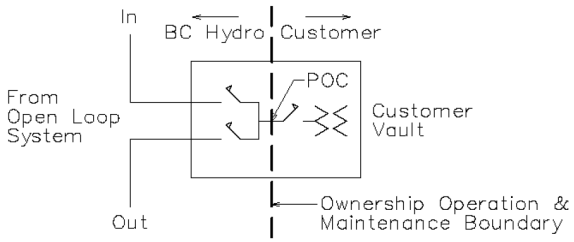
9 TYPES OF BUILDING VAULTS

The following table shows the variations of primary service configurations and the ownership/ maintenance responsibilities for the equipment in the building vaults:

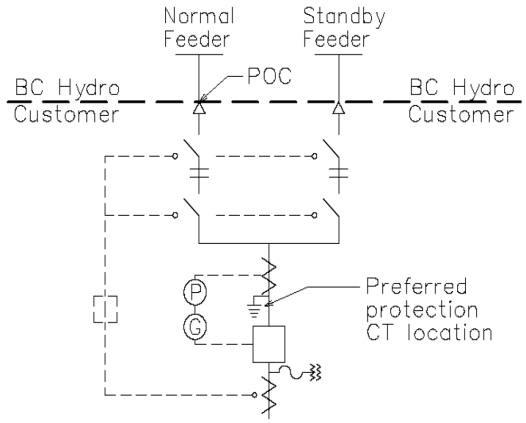
Table 1 – Building Vault Types

Primary Service Supply Configuration	One Line Diagram	Ownership/Maintenance Responsibility
1. Single Radial – The most common configuration for UG supply province wide. All equipment is owned by the customer except for a few old installations. see Single Radial configuration in 2 below.		Customer owns and maintains equipment up to POC
2. Single Radial - In greater Victoria, BC Hydro owns primary switch and oil filled transformers.		BC Hydro owns the Primary switch and live front oil filled transformers. BC Hydro maintains equipment up to POC A list of these vaults in Victoria is available from the Program Engineer.

BC Hydro	Distribution Maintenance Standard	
Subject: BUILDING VAULT INSPECTIONS AND MAINTENANCE	**Number:**	ES-64-C-03.05
	Revision:	2
	Date: August 26, 2020	**Page** 6 of 15

3. Dual Supply – This configuration is similar to single radial supply where Customer owns all the equipment in the vault. This configuration is for large connected loads and BC Hydro is the only one who is authorized to operate those switches. Some examples of this configuration are: VGH and Metrotown.		Customer owns and maintains equipment up to POC. For switches under BC Hydro operating authority, the customer must demonstrate that these switches are maintained every three years and are in good operating condition.
Primary Service Supply Configuration	**One Line Diagram**	**Ownership/Maintenance responsibility**
4. Primary Loop -An obsolete supply configuration used in Whalley and downtown Victoria only.		BC Hydro owns and maintains the primary air insulated disconnects and load break switches up to POC. A list of these vaults is available from the Program Engineer.

BC Hydro Standard ES-64-C-03.05 *Building Vault Inspections and Maintenance*, revision 2, 26 August 2020 (page 6 of 15)

5. Dual Radial – An obsolete supply configuration comprising a running and standby feeders used mainly in Downtown Vancouver.		Customer owns and maintains equipment up to POC except for a few dual radial vault installations in Vancouver where BC Hydro owns and maintains the dual radial equipment. A list of these vaults is available from the Program Engineer. For switches under BC Hydro's operating authority, the customer must demonstrate that these switches are maintained every three years and are in good operating conditions.

For the open loop system in Downtown Vancouver, BC Hydro requires a Vista Switchgear room to be installed in the customer building. The Vista Switchgear room is generally located adjacent to the customer Building Vault. The Vista Switchgear inside the Vista Switchgear room is owned and maintained by BC Hydro and normally feeds the Building Vault via a Single Radial or Dual Supply configuration. Follow Distribution Maintenance Standard ES-64-C03.07 for instructions on how to inspect Vista Switchgear in these rooms.

10 CUSTOMER'S RESPONSIBILITIES FOR MAINTENANCE AND IDENTIFICATION OF HAZARDS IN VAULTS

In order for BC Hydro to keep its workers safe, BC Hydro requires:

- Customers to notify BC Hydro of any hazards in Building Vaults including but not limited to the existence and condition of Asbestos, location of Confined Spaces and any other hazards that BC Hydro crews may encounter during routine or emergency response; and
- Customers selected Vault equipment to maintain their equipment and provide records accordingly as required in Table 1 above.

11 PROCEDURE

11.1 Review Existing SAM Maintenance Records

11.1.1 General

Prior to performing the work, review existing Asbestos Inventory, Confined Space information in Zone Awareness, Butterfly Diagram, Picture Reports and SAM records for Asset Data, Action Requests, Tasks and Data Correction to identify duct type, hazards and defects that may require additional attention during the inspection. Update inventory in SAM and use a Data Correction where fields are read-only in SAM.

11.1.2 Asbestos Inventory

Asbestos identified during inspections must be brought to the attention of a Qualified Person for documenting into the Distribution Asbestos Inventory System. This will include Asbestos found in BC Hydro equipment (cable wraps, gaskets, etc. as well as Asbestos in Customer owned equipment (ducts, cable wrap, etc.) SAM will be updated accordingly to match the records in the inventory system.

For known Asbestos in the Vault, review and update the status of the Asbestos in accordance with Asbestos Safe Work Procedures.

11.1.3 Confined Space Inventory

Ensure that vaults and manholes beneath equipment not already identified in the GIS are updated accordingly and any discrepancies.

Raise a Data Correction in SAM to identify any confined spaces that are not currently documented in SAM.

11.1.4 PCB Inventory

Update the manufacturer name and date of manufacture of all transformers.

If a transformer now has a White PCB sticker or if the unit is manufactured is 1986 or later change the PCB Tag Code in GIS to “W” regardless of the sticker colour in the unit. Change the PCB Level to “1”. Alternatively raise a Data Correction in SAM indicating the manufacturer name, date manufactured of the unit installed.

11.1.5 Document Vault Single Line Diagram

Review the Internal Single Line Diagram of the Vault within SAM. Document an updated Single Line Diagram for the Vault and return to the Distribution Maintenance Analyst for updating the Internals in SAM.

11.1.6 Other

Update the type, manufacturer name and date of manufacture of all switchgear and other equipment in the vaults.

11.2 Minor Repairs

Minor problems shall be corrected, if feasible, during the inspections, as long as these procedures are permitted under applicable work methods and IBEW Agreements (i.e. removing debris against the structure, tightening or replacing missing bolts, oiling of hinges, replacing decals, etc.).

11.3 Inspections

11.3.1 Vault (General Inspection)

- Ensure that the vault is accessible and the entrance is unobstructed;
- Ensure that the vault is secure: key is in a lock box or available when required; locks and latches function properly;
- Ensure that the vault is properly labelled with a high voltage and vault number;
- Ensure that the lighting is working properly;
- Ensure that the drainage sump (if applicable) is not plugged – clean if necessary. Report the presences of water in the vault.
- Ensure that the floor is clean, and note needed repairs to the walls, and ceiling.
- Check for signs of chewed insulation, faeces, etc. that likely caused by rodents, rats and mice. Report cable damage.
- Inspect terminators, cable insulations, cable jackets, anti-tracking tapes, etc. Report damage, signs of deterioration and other abnormal conditions.
- Report oil leaks for Customer owned transformers to the Customer's representative. See below for instructions on BC Hydro owned transformers.

11.3.2 Transformers

- Ensure that the transformer tanks are property grounded;
- Inspect the transformer tanks, bushings, gaskets, and connections for corrosion, damage, overheating (use infrared thermometer), and oil leaks. All oil leaks must be contained and reported to the field operations manager for review and corrective action;
- Record the oil level and temperature if available;
- Check the surface temperature of the transformer tanks using an infrared thermometer, and compare the surface temperature with the ambient temperature;
- Check and record the transformer load using a clip-on ammeter on the secondary leads of the transformers.
- Check for the presence of fresh oil on various surfaces. If oil is present, take multiple photos clearly showing:
  - extent and location of leak,
  - nameplate and PCB tag (if present) of unit, and
  - any evidence of oil entering drains or ducts.
- See Appendix A to classify leak severity and actions to be taken.

11.3.3 Buswork

- Inspect primary and secondary buswork, insulators and supports;
- Inspect wall mounted power fuses, check if they are equipped with attachments (hooks) for loadbuster and note it on the inspection & maintenance checklist;
- Check for overheated connections both the primary and the secondary buswork including the bushing connections using an infrared thermometer.

11.3.4 Air Insulated Switchgear Compartment

- Ensure that the compartment is properly grounded;
- Note needed repairs to the enclosure such as corrosion, paint, operation of doors and latches, etc.;
- Inspect the internal buswork, insulators, and supports for damage and needed maintenance through the viewing window;
- Inspect the condition of the disconnects, loadbreak switches, fuses for damage and needed maintenance through the viewing window.

11.3.5 Other Oil Filled Equipment

- Report the presence of any other oil filled equipment including Primary Metering equipment or protection such as oil filled Cutouts. Raise an Action Request in SAM to recommend replacement of this equipment or a raise a Data Correction if the equipment is not documented in SAM. Take several photos of the equipment and attach to the Action Request or the Data Correction raised.

11.3.6 Grounding System

- Make sure that all grounding and bonding connections are intact and tight. These should include enclosure grounding and flexible connections to doors, etc. Repair or report broken, loose corroded or discoloured connections. Ensure that the concentric neutrals of the feeder cables are bonded to the system grounding (one strand to the terminator's grounding eye or mounting bracket).

12 DOCUMENTS AND RECORDS

Record of the inspections and details of proposed remedial action shall be made and kept in the Spatial Asset Management (SAM) System.

Complete all required SAM Task data and attached photos to the Tasks as required to show asset conditions found.

Defects and recommendations for repairs, replacements or follow-up inspections shall be recorded as Action Requests in SAM with sufficient additional information to explain the nature of the defect (Comments section). Classification of defects and the priority level shall be assigned in the Action Requests as follows:

P1 - Fix within 90 days
P2 - Fix within 12 months
P3 - Fix in within 18 months
P4 - Inspection on increased frequency
P5 - Inspection on normal frequency

Photos of all defects and hazards shall be taken and attached to Action Requests created.

Create SAM Data Corrections to record discrepancies between what is found in the Field and what is shown in SAM Field. Attach photos to the Data Corrections to articulate the discrepancy for follow up by BC Hydro.

13 POST INSPECTION

Before leaving the structure, close all doors and openings, and lock all padlocks. Ensure that all security bolts are in place and tight. 'Circle-check' the structure to ensure that it is safe and secure, and no debris, tools, etc. have been left on site.

14 DEFECT REMEDIATION

Action Requests entered in SAM will be further risk-assessed by the Program Engineer and scheduled for remediation as funding is available.

15 REVISION NOTES

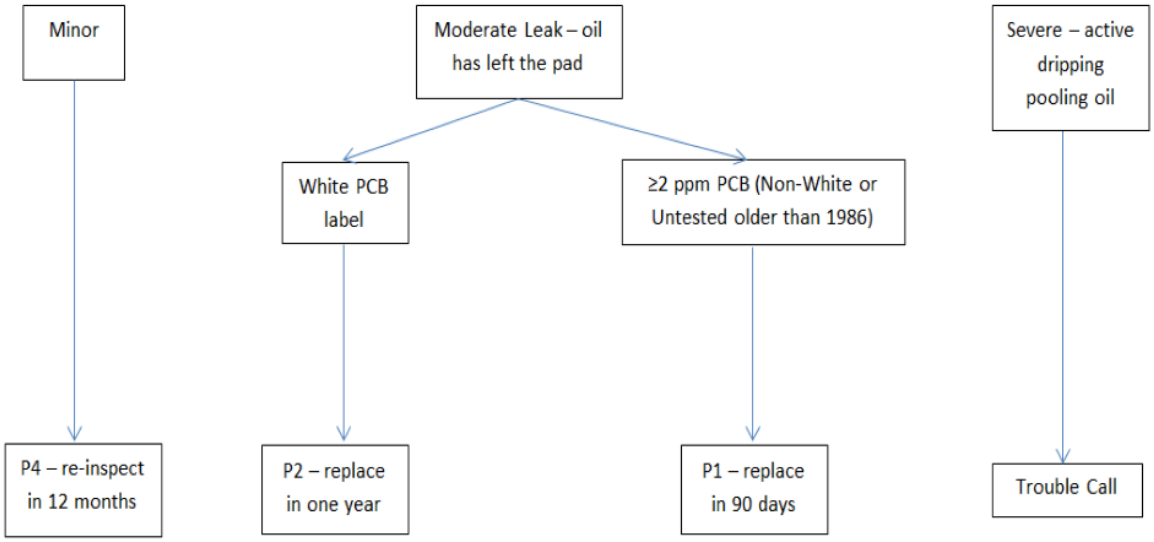
Revision 2: Inspection frequency changed to every 3 years, added Asbestos, Confined Space and PCB requirements.

Revision 1: Rewrite and reformatting.

BC Hydro	Distribution Maintenance Standard	
Subject: BUILDING VAULT INSPECTIONS AND MAINTENANCE	**Number:**	ES-64-C-03.05
	Revision:	2
	Date: August 26, 2020	**Page** 12 of 15

16 APPENDICES

16.1 APPENDIX A: Oil Leak (BC Hydro Owned Transformers) Priority Flowchart



BC Hydro Standard ES-64-C-03.05 *Building Vault Inspections and Maintenance*, revision 2, 26 August 2020 (page 12 of 15)

16.2 APPENDIX B: Building Vault Inspection and Maintenance Checklists

Inspection and Maintenance Checklist for BC Hydro Owned Switchgear and Oil Filled Transformer
(For Reference Only – All data must be completed in SAM Field)

This inspection and maintenance form is for:

- Single Radial Vaults in Victoria
- Dual Radial Vaults in Vancouver

Vault Number: _____
Vault Configuration:

☐Single Radial
☐Dual Supply
☐Dual Radial
☐Primary Loop

Circuit:

☐Running Circuit _____
☐Standby Circuit (for Dual Radial) _____

Vault Structure – General

☐Vault door is secure
☐Locks and latches properly function
☐Vault lighting is adequate
☐Thermostat is working correctly and setting is 22 degrees C
☐Minimal dust accumulation. Clean and vacuum as required
☐No storage items present
☐Drain sump and pump in good operating condition

TRANSFORMER

☐Transformer tanks are grounded
☐Seismic anchoring is secure
☐Bushings, connections and gaskets have no visible leaks
☐Bushings, connections and gaskets have no visible corrosion
☐Indicate IR Reading _____. Difference between transformer surface temperature and ambient temperature is acceptable following test with infrared camera
☐Inspect and Torque bolt connector
☐Resistance Measurements _____
☐Oil Samples:

- ☐Dissolve Gas Analysis (DGA)
- ☐PCB

BC Hydro	Distribution Maintenance Standard	
Subject: BUILDING VAULT INSPECTIONS AND MAINTENANCE	**Number:**	ES-64-C-03.05
	Revision:	2
	Date: August 26, 2020	**Page** 14 of 15

SWITCHGEAR

☐Switches are in good mechanical condition. Lubricate mechanism.
☐Inter-phase barriers are in good condition. Clean barriers.
☐Key interlock functions properly (if Applicable).
☐Contacts are in good condition. Burnish and lubricate.
☐Perform contact resistance test@100 amp dc.
☐Ensure that BC Hydro supply cable has proper termination, grounding and support

BC Hydro Standard ES-64-C-03.05 *Building Vault Inspections and Maintenance*, revision 2, 26 August 2020 (page 14 of 15)

BC Hydro	Distribution Maintenance Standard	
Subject: BUILDING VAULT INSPECTIONS AND MAINTENANCE	**Number:**	ES-64-C-03.05
	Revision:	2
	Date: August 26, 2020	**Page** 15 of 15

Inspection and Maintenance Checklist for Customer Owned Switchgear Operated by BC Hydro
(To be completed by Customer crews or by BC Hydro crews if attending the site)

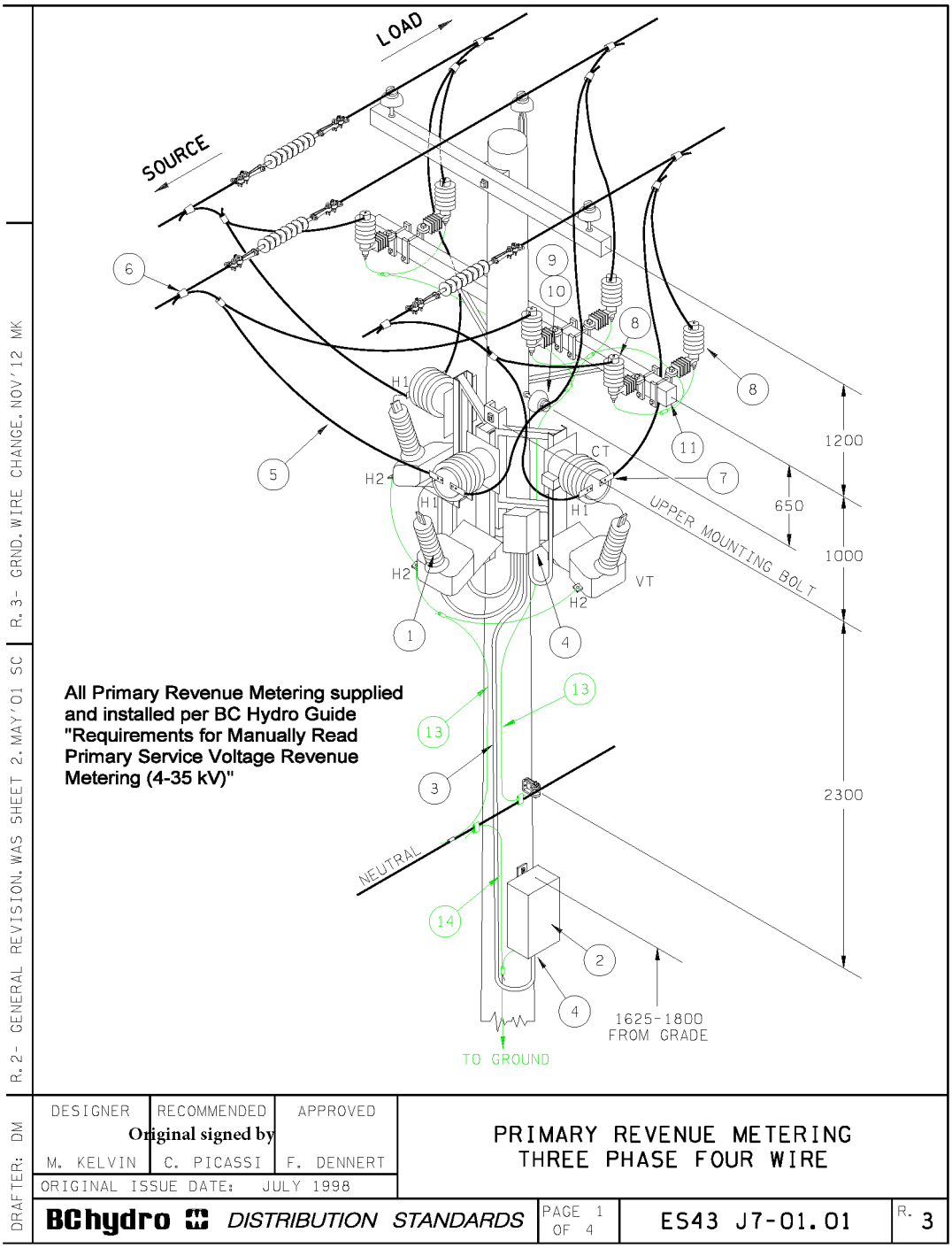
Vault Number: _____
Vault Configuration:
- ☐Single Radial
- ☐Dual Supply
- ☐Dual Radial
- ☐Primary Loop

Circuit:
- ☐Running Circuit _____
- ☐Standby Circuit (for Dual Radial) _____

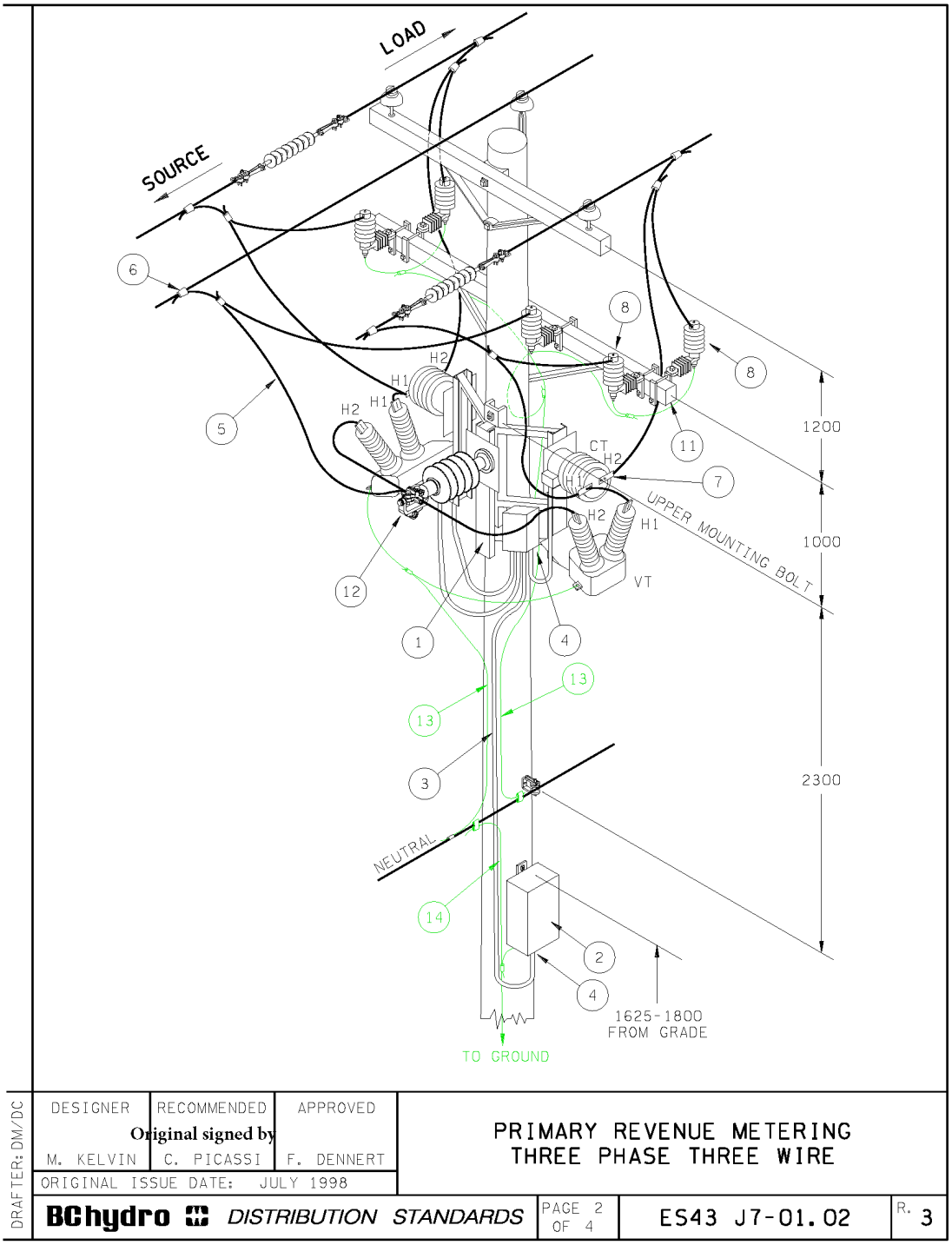
Vault Structure – General
- ☐Vault door is secure
- ☐Locks and latches properly function
- ☐Vault lighting is adequate
- ☐Thermostat is working correctly and setting is 22 degrees C
- ☐Minimal dust accumulation. Clean and vacuum as required
- ☐No storage items present
- ☐Drain sump and pump in good operating condition

SWITCHGEAR

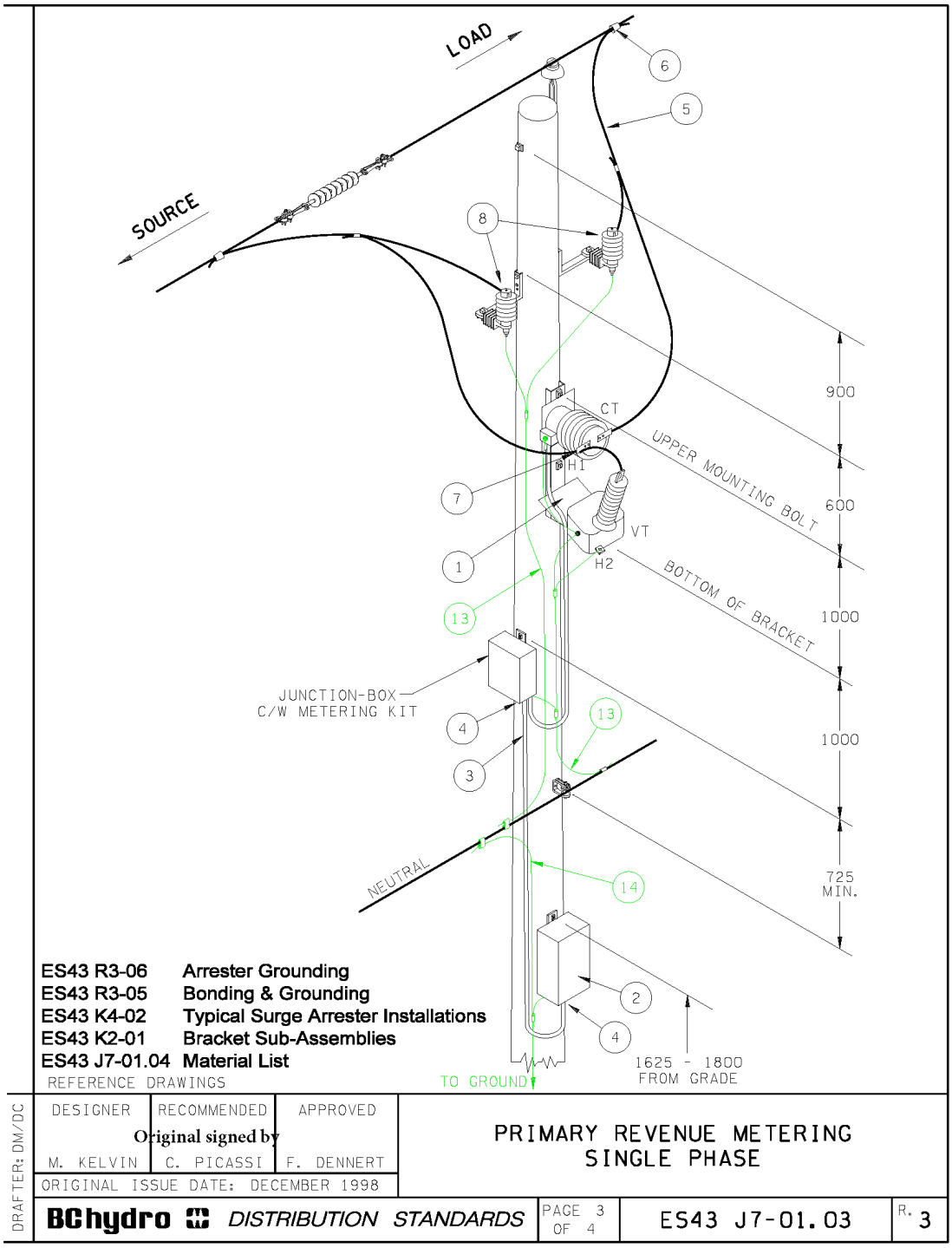
☐Bus and insulators are in good electrical and mechanical condition
☐Switches are in good mechanical condition.
☐All Insulators must be clean
☐All electrical and mechanical interlock systems operate correctly.
☐Contacts are in good condition.
☐Perform contact resistance test@100 amp dc.
☐Ensure that BC Hydro supply cable has proper termination, grounding and support



BC Hydro Standard ES43 J7-01 *Primary Revenue Metering Three Phase Four Wire* (page 1 of 4)



BC Hydro Standard ES43 J7-01 *Primary Revenue Metering Three Phase Four Wire* (page 2 of 4)



BC Hydro Standard ES43 J7-01 *Primary Revenue Metering Three Phase Four Wire* (page 3 of 4)

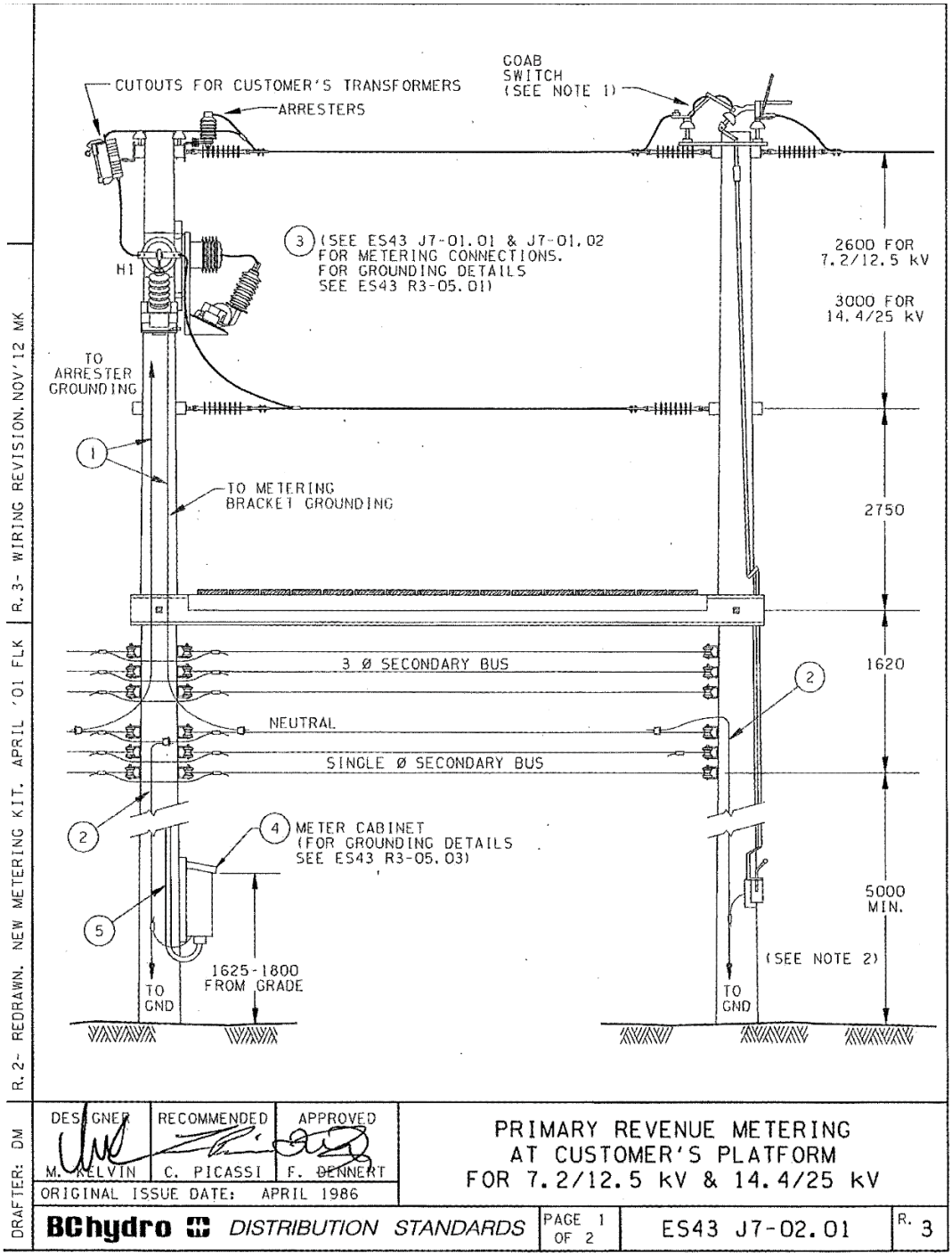
ITEM #	DESCRIPTION	STOCK NO.	QUANTITY
1	METERING KIT		1
	25kV class, 3Ph., 4 wire, VT: 14,400-120, CT: 10-5	362-6037	
	25kV class, 3Ph., 4 wire, VT: 14,400-120, CT: 25-5	362-6330	
	25kV class, 3Ph., 4 wire, VT: 14,400-120, CT: 50-5	362-6039	
	25kV class, 3Ph., 4 wire, VT: 14,400-120, CT: 100-5	362-6031	
	25kV class, 3Ph., 4 wire, VT: 14,400-120, CT: 200-5	362-6032	
	25kV class, 3Ph., 4 wire, VT: 14,400-120, CT: 300-5	362-6033	
	25kV class, 3Ph., 4 wire, VT: 14,400-120, CT: 400-5	362-6034	
	15kV class, 3Ph., 4 wire, VT: 7,200-120, CT: 10-5	362-5037	
	15kV class, 3Ph., 4 wire, VT: 7,200-120, CT: 25-5	362-5330	
	15kV class, 3Ph., 4 wire, VT: 7,200-120, CT: 50-5	362-5039	
	15kV class, 3Ph., 4 wire, VT: 7,200-120, CT: 100-5	362-5031	
	15kV class, 3Ph., 4 wire, VT: 7,200-120, CT: 200-5	362-5032	
	15kV class, 3Ph., 4 wire, VT: 7,200-120, CT: 300-5	362-5033	
	15kV class, 3Ph., 4 wire, VT: 7,200-120, CT: 400-5	362-5034	
	15kV class, 3Ph., 3 wire, VT: 12,500-120, CT: 400-5	Contact RMSM	
	25kV class, 1Ph., 2 wire, VT: 14,400-120, CT: 10-5	362-6117	
	25kV class, 1Ph., 2 wire, VT: 14,400-120, CT: 25-5	362-6110	
	15kV class, 1Ph., 2 wire, VT: 7,200-120, CT: 10-5	362-5117	
	15kV class, 1Ph., 2 wire, VT: 7,200-120, CT: 25-5	362-5110	
2	METER CABINET	372-9204	1
3	TECK CABLE		10m
	11 conductor, for 3 ph	380-4545	
	4 conductor, for 1 ph	380-4555	
4	CABLE FITTING		2
	11 conductor, for 3 ph	390-1125	
	4 conductor, for 1 ph	390-1122	
5	POLYETHYLENE COVERED CONDUCTOR		As required
	200 amps and less: #2 Cu	380-0256	
	201 to 400amps: 4/0 Cu	380-0261	
6	AMPACT CONNECTORS		3 Ph 1 Ph
	#2 ACSR TO #2 Cu	388-0531	9 3
	366.4 ASC TO 4/0 Cu	388-0825	
7	COMPRESSION SPADE CONNECTORS		3 Ph 1 Ph
	#2 Cu	388-1030	6 2
	4/0 Cu	388-1035	
8	SURGE ARRESTERS		3 Ph 1 Ph
	9kV rating, for 7.2 / 12.5kV system	351-0013	6 2
	18kV rating, for 14.4 / 25kV system	351-0016	
9	PIN INSULATOR 14.4 / 25kV	410-0649	1
10	DROP LEAD INSULATOR PIN	421-0311	1
11	9' CROSS ARM	421-0022	1
12	INSULATOR, HORIZONTAL LINE POST, 25kV	410-0681	1
13	#4 AWG PE COVERED Cu CONDUCTOR	380-5051	As required
14	THEFT DETERRENT GROUNDING WIRE	96006427	As required

DRAFTER: DM

DESIGNER	RECOMMENDED	APPROVED	PRIMARY REVENUE METERING BILL OF MATERIAL
M. KELVIN	Original signed by C. PICASSI	F. DENNERT	
ORIGINAL ISSUE DATE: JUNE 2001			

BCHydro DISTRIBUTION STANDARDS | PAGE 4 OF 4 | ES43 J7-01.04 | R. 3

BC Hydro Standard ES43 J7-01 *Primary Revenue Metering Three Phase Four Wire* (page 4 of 4)



BC Hydro Standard ES43 J7-02 *Primary Revenue Metering at Customer's Platform for 7.2/12.5 kV & 14.4/25 kV* (page 1 of 2)

NOTES:

1. Customer's platform and accessories shown are typical only. If maintenance is done by BC Hydro, GOAB switch may be omitted and structure must comply with BC Hydro Standards.
2. Customer owned GOAB switch shall comply to CEC Part 1 Section 36 and include safety ground mat per ES43 R3-07.

Item	Description	Catalogue ID	Quantity
1	#4 AWG PE Covered Cu Conductor	380-5051	As Required
2	Theft Deterrent Grounding Wire	96006427	As Required
3	Metering Kit (see ES43 J7-01.04)	BCH	1
4	Metering Cabinet (see ES43 J7-01.04)	372-9204	1
5	Teck Cable II Conductor for 3 Ph Metering	380-4545	1

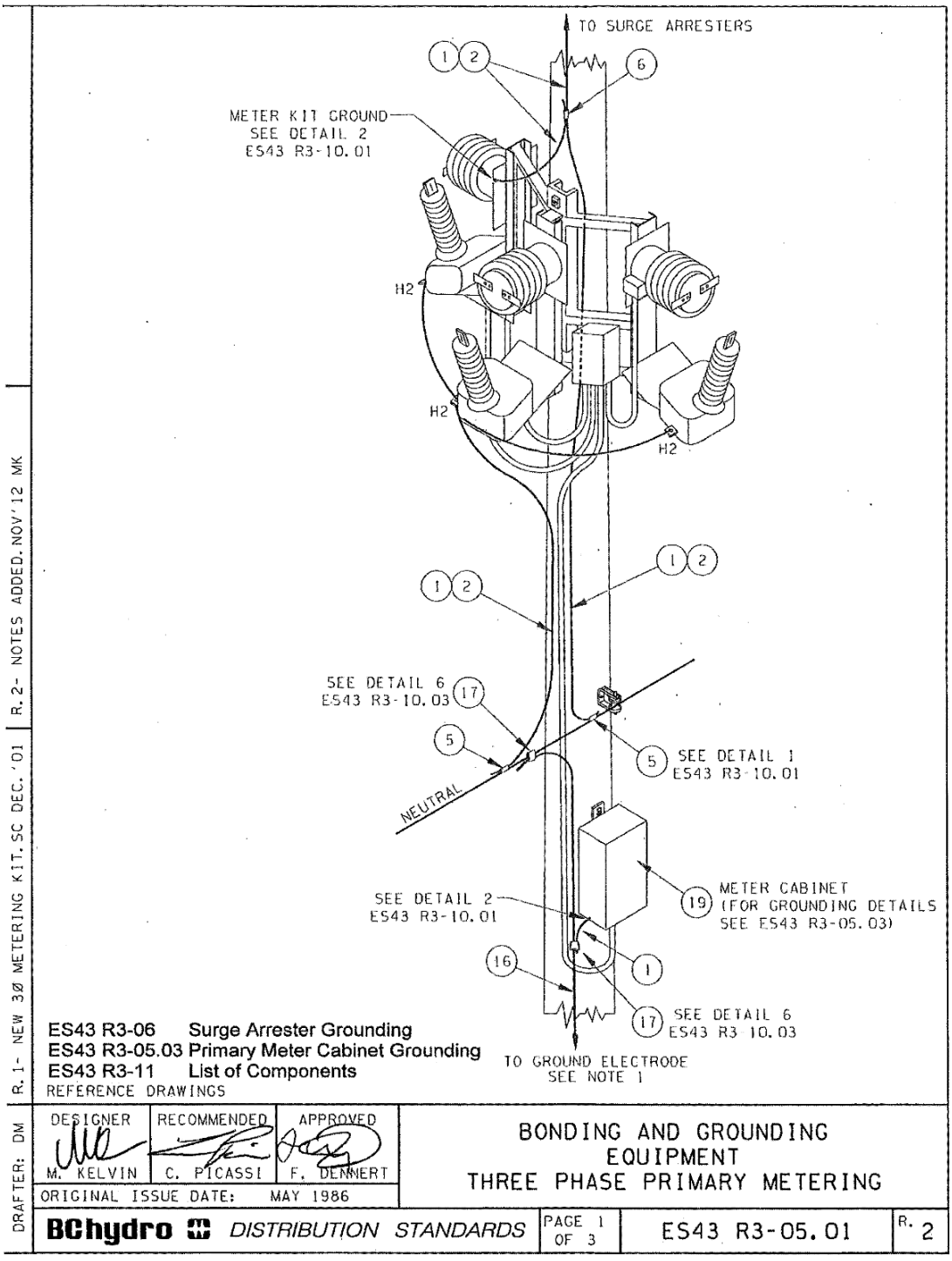
"BCH Requirements for Manually Read Primary Service Voltage Revenue Metering (4-35 kV)"
ES43 R3-06 Surge Arrester Bonding & Grounding
ES43 R3-05 Metering Kit Bonding & Grounding
ES43 K2-01 Cutout & Arrester Mounting
ES43 J7-01.01 Three Phase Primary Metering
REFERENCE DRAWINGS

DRAFTER: DM

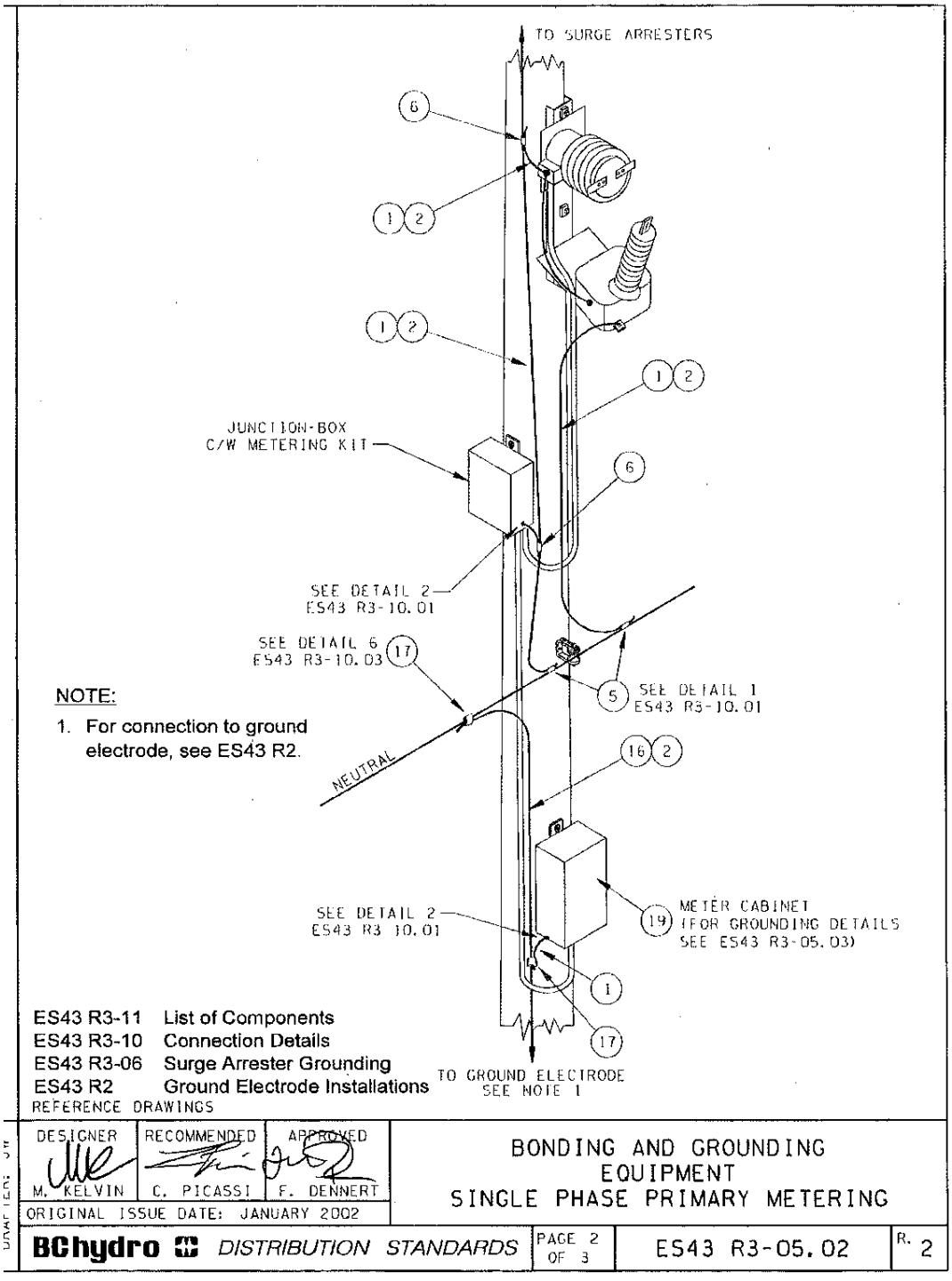
DESIGNER	RECOMMENDED	APPROVED	REVENUE METERING PRIMARY - AT CUSTOMER'S PLATFORM BILL OF MATERIAL & NOTES
M. KELVIN	C. PICASSI	F. DEINERT	
ORIGINAL ISSUE DATE: DECEMBER 2010			

BCHydro DISTRIBUTION STANDARDS | PAGE 2 OF 2 | ES43 J7-02.02 | R. 3

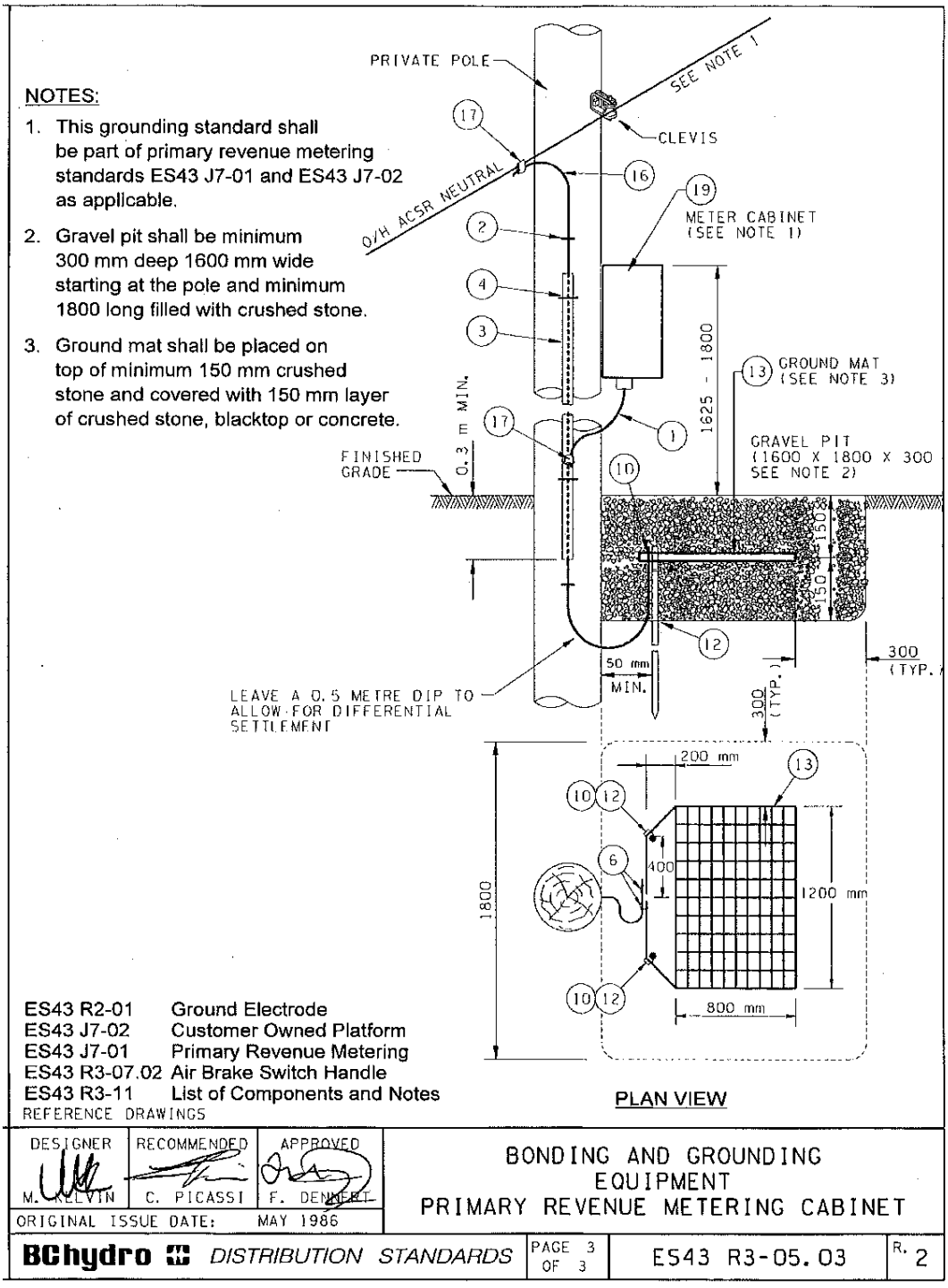
BC Hydro Standard ES43 J7-02 *Primary Revenue Metering at Customer's Platform for 7.2/12.5 kV & 14.4/25 kV* (page 1 of 2)



BC Hydro Standard ES43 R3-05 *Bonding and Grounding Equipment Three Phase Primary Metering* (page 1 of 3)



BC Hydro Standard ES43 R3-05 *Bonding and Grounding Equipment Three Phase Primary Metering* (page 2 of 3)



BC Hydro Standard ES43 R3-05 *Bonding and Grounding Equipment Three Phase Primary Metering* (page 3 of 3)

LIST OF COMPONENTS

Item No.	Description	Catalogue ID
1	#4 Awg Cu Gnd.Conductor P. E. Covered	380-5051
2	Staple, Ground Conductor	103-0224
3	Moulding, Ground Conductor	388-5221
4	Staple, Conductor Moulding	103-0228
5	Compression Connector H-Type	388-0514
6	Compression Connector C-Type	388-0453
7	Split Stud Connector	388-2103
8	3/8" Nut, Hex, Galvanized	102-0122
9	3/8" Washer, Spring, Galvanized	102-4154
10	Ground Rod/Ground Wire Connector	420-1158
11	Ground Rod/Counterpoise Connector	420-1157
12	Ground Rod	420-1093
13	Ground Mat (800 mm x 1200 mm)	350-8810
14	Wire Rope Counterpoise (7 m)	106-2510
15	U-Bolt Clamp	420-0965
16	Theft Deterrent Galvanized Grounding Wire	96006427 or 96006428
17	Miniwedge, Erico	96006696, 96006695, or 96006667 as per ES43 R2-01
18	1/2" Split Stud Connector	97000053
19	Meter Cabinet	372-9204

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA C. PICASSI # 35602 Oct 27/14

ES43 R3-10 Connection Details
ES43 R2-01 Ground Electrode Installations
REFERENCE DRAWINGS

R.2- ITEM 16, 17, 18 & 19 ADDED. NOV'12 MW | R.3- ITEM 18 UPDATED. NOV'14 MS

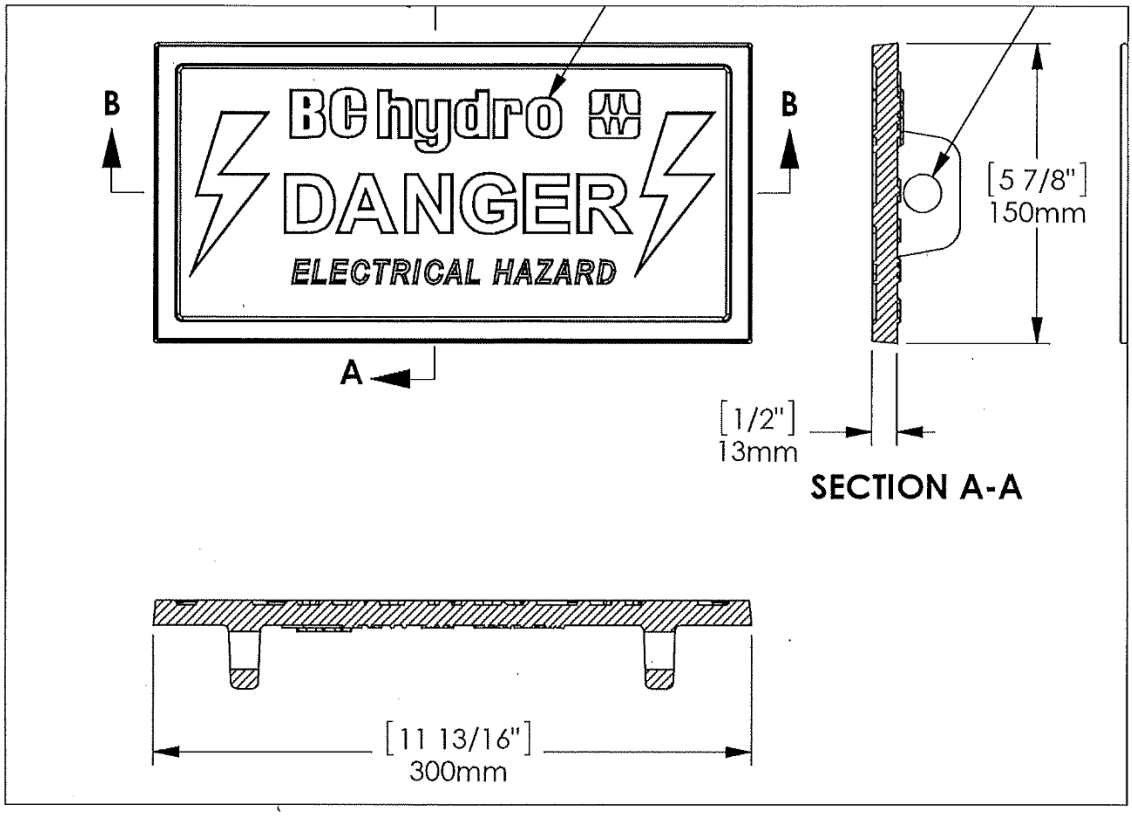
DRAFTER: DC

DESIGNER	RECOMMENDED	APPROVED
M. SCHAEFER	C. PICASSI	F. DENNERT
ORIGINAL ISSUE DATE: MAY 1986		

BONDING AND GROUNDING EQUIPMENT LIST OF COMPONENTS

BCHydro DISTRIBUTION STANDARDS | PAGE 1 OF 1 | ES43 R3-11 | R. 3

BC Hydro Standard ES43 R3-11 *Bonding and Grounding Equipment List of Components*



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-owned recloser and BC Hydro primary revenue metering

Figure A3-8. Customer service switch and O/C protection on first pole
and BC Hydro primary revenue metering on second pole

Figure A3-9. Customer-owned dead-front kiosk with both doors closed

Figure A3-10. Dead-front kiosk both doors open showing grounding switch above and service cable bushings below

Figure A3-11. Service cable clamps and adjustable cable support channel

Figure A3-12. Close-up of dead front BC Hydro utility service cable compartment with terminators, cable supports, and grounding

Figure A3-13. Dead front primary service kiosk by Power Systems Technology showing service main

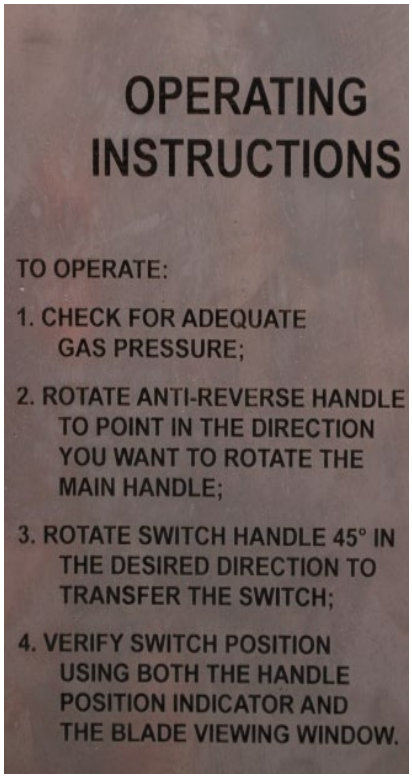


Figure A3-14. Operating instructions

Figure A3-15. BC Hydro utility cable compartment and cable supports and grounding

Figure A3-16. BC Hydro grounding position lock

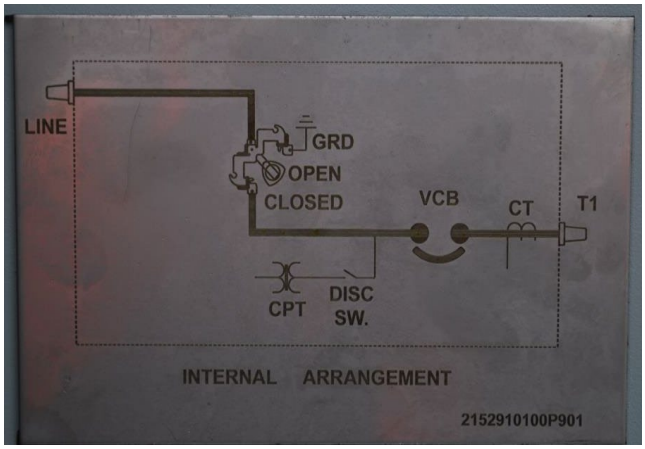


Figure A3.17. Mnemonic single line diagram

Figure A3-18. Dead-front primary service kiosk by S&C Electric showing BC Hydro as Way 1 and customer service main as Way 2

Figure A3-19. Dead-front primary service kiosk by S&C Electric with BC Hydro as Way 1 and customer service main as Way 2, covers open

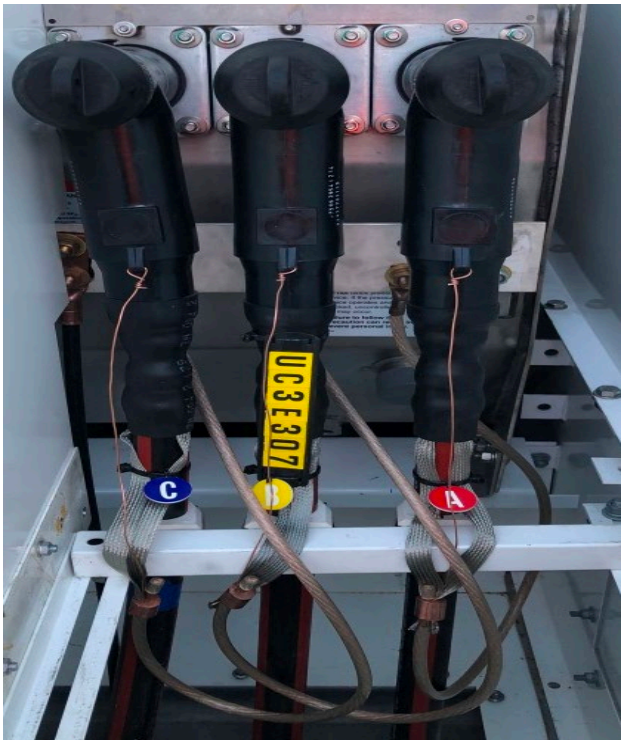


Figure A3-20. BC Hydro utility cable compartment and cable supports and grounding

Figure A3-21. BC Hydro grounding position lock

Figure A3-22. Mnemonic single line diagram and customer locks