Generator Systems
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GENERATOR SYSTEMS

GENERAL REQUIREMENTS

Emergency electrical power supply

Definition:
The in-house generation of electrical energy for supplying a load requiring emergency power when the normal power supply fails. The BC Building Code mandates the installation of emergency electrical power supplies.

References

BC Building Code “Life safety equipment”
- Fire alarm and emergency voice communication systems
- Fire fighter’s elevators and elevators serving floors above the first storey in a high building
- Fire protection water supply pumps
- Smoke control systems
- Fans required for smoke venting
- Emergency lighting
- Exit signs that depend on electrical power supplied to the building

CSA Standard C282 - 09 Emergency electrical power supply for buildings
- Covers all aspects including initial installation, performance tests, maintenance and scheduled testing
- 11 major sections
- Includes references to other installation codes

Other publications referenced in CSA C282-09:
- Can/CSA–B149.1-05 Natural gas and propane installation code
- C22.1-09 Part 1 Canadian Electrical Code
- C22.2 No. 100-04 (R2009) Motors and generators
- C22.2 No. 141-02 (R2007) Unit equipment for emergency lighting
- C22.2 No. 178.1-07 Requirements for transfer switches
- Can3–C235-83 (R2006) Preferred voltage levels for AC Systems
- C282 Logbook-09 Maintenance logbook
- CSA Z32-09 Electrical safety & essential electrical systems in health care facilities
Emergency power supply system installations:
- Equipment must be CSA C282 - 09 approved
- Equipment including transfer switches shall be approved for the purpose
- Additional requirements for Health Care Facilities
- Design to be certified by BC registered P.Eng
- Must meet BC Electrical Code requirements

Standby electrical power supply

Definition:
- A reserve or substitute power supply
- Installed by the owner as a matter of convenience when normal Hydro power is interrupted
- BC Building Code and BC Electrical Code Section 46 do not apply
- Other local bylaws (generator location or noise) or other Safety Codes may apply

Other authorities having jurisdiction

Building inspection:
- Installation requires structural support (i.e. roof/deck mount)
- Location in relation to windows / building openings
- Exhaust emissions (carbon monoxide)
- Area subject to flooding

Bylaw enforcement:
- Noise generated
- Location of generator (too close to neighbors)

Gas inspection and permits may be required:
- Where natural gas or propane is used as fuel
- At -5°C, propane available as a vapor (fuel) is approximately half the volume of the tank.
- At -28°C, propane will not vaporize.
- Clearance requirements from combustibles should be considered.
Fire Services may need to be consulted depending on the:

- Amount of fuel that will be stored on site (gas or diesel)
- Location of fuel tanks
- Construction of fuel tanks
- Accessibility for fire fighting

**Electrical inspection authorities:**

- Electrical permits required prior to doing electrical work
- Electrical Safety Regulations
- Work performed by qualified workers
- Installation must comply with BC Electrical Code
Use of Approved Equipment

Use of approved equipment:

- See Electrical Safety Regulation, Section 21 - 1(a)
- See BC Electrical Code, Rule 2 - 024
- See BCSA Information Bulletin B - E3 071019 3 Approved Certification Marks for Electrical Products
- Beware of counterfeit equipment
- Offshore generators may not be approved but are available in Canada

Electrical Safety Regulation
Section 21 - 1(a)
Certification or approval mark required for electrical equipment

Subject to subsections (3) and (4), a person must not use electrical equipment in British Columbia, or offer for sale, sell, display or otherwise dispose of electrical equipment for use in British Columbia, unless the electrical equipment displays a label or mark as follows:
(a) a certification mark

Canadian Electrical Code
Rule 2 - 024
Use of approved equipment

Electrical equipment used in electrical installations within the jurisdiction of the inspection department shall be approved and shall be of a kind or type and rating approved for the specific purpose for which it is to be employed.
GENERATOR LOADING AND SIZING

How to size a generator

The code does not have specific rules to guide us for this task.

Rules to consider:

- **Rule 8 - 104 subrules 1 - 5**
  - Subrule (1) says the rating of a feeder or branch circuit is based on the rating of the overcurrent device or conductor ampacity, whichever is smaller.
  - Subrule (2) states the calculated load on a circuit shall not exceed the ampere rating of the circuit.
  - Subrules (3), (4) & (5) provide requirements to determine whether circuits are considered continuous or not, and loading of panel boards based on whether equipment is rated for use at 100% or 80% of the equipment nameplate ratings.

- **Rule 8 – 106 (3), (5) & (8)**
  - Subrule (3) indicates we may use transfer switches/panel board or automatic systems such as load misers to control loads on a circuit or system.
  - Subrule (5) allows the installer to consider cyclic loads that can be demonstrated to be predictably intermittent or cyclic as you may encounter in commercial process or manufacturing process facilities.
  - Subrule (8) provides the use of maximum demand loads over a 12 month period to be used when calculating service or feeder ampacity in an existing installation.

Other things to consider:
- Are loads intermittent or continuous?
- Check with the manufacturer of the generator for loading factors.

**Single family standby example**

<table>
<thead>
<tr>
<th></th>
<th>Amps</th>
<th>Volts</th>
<th>Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well pump</td>
<td>8</td>
<td>240</td>
<td>1920</td>
</tr>
<tr>
<td>Fridge circuit (1 receptacle)</td>
<td>8</td>
<td>120</td>
<td>960</td>
</tr>
<tr>
<td>1 general lighting / receptacle circuit</td>
<td>12</td>
<td>120</td>
<td>1440</td>
</tr>
<tr>
<td>2 pole kitchen appliance circuit (2 receptacles)</td>
<td>12</td>
<td>240</td>
<td>2880</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>7200W</strong></td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
<td>30A</td>
</tr>
</tbody>
</table>
Notes: Rule 8 - 304
- Subrule (1) 12 outlets on any 2-wire branch circuit
- Subrule (2) states that each outlet = 1 amp
- Subrule (3) allows more diversity if the load is known, therefore lights could be added at their rating.

Therefore, a generator and feeder rated at 7.2kW would be required. Please note that the manufacturer’s generator loading factor should be considered when sizing the unit.

Alternate Single family standby example

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Well pump</td>
<td>8A x 240V</td>
<td>1920</td>
</tr>
<tr>
<td>Fridge circuit -1 receptacle</td>
<td>8A x 120V</td>
<td>960</td>
</tr>
<tr>
<td>1 lighting circuit</td>
<td>8 lamps x 50 watts</td>
<td>400</td>
</tr>
<tr>
<td>2nd lighting circuit feeding</td>
<td>10 lamps x 50 watts each</td>
<td>500</td>
</tr>
<tr>
<td>1 general purpose circuit feeding total of 10 outlets</td>
<td>10 outlets x 120V x 1 A</td>
<td>1200</td>
</tr>
<tr>
<td>1 general purpose circuit, total 4 outlets</td>
<td>4 x 120V x 1A</td>
<td>480</td>
</tr>
<tr>
<td>1-1pole kitchen appliance circuit (5-20R)</td>
<td>16A x 120V</td>
<td>1920 W</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>7380 W</strong></td>
</tr>
</tbody>
</table>

In this example we have installed lighting equipment with a known load. The general logic of Rule 8-304(3) which allows us to increase the number of outlets on a circuit where we have a known load provides the rationale for this method. We have changed the kitchen receptacle to circuit feeding only one kitchen counter outlet rated 20 amps and 120 volts. We have reduced the total number of receptacles on the circuit feeding the entertainment equipment and the general purpose circuit. We have used the provisions of 8-304(2) to arrive at this reduced load for these circuits.

This method may provide some relaxation to calculated loads but requires planning at the initial stage of the job. When reducing load calculation requirements for lighting and other loads as shown in this example it is recommended you communicate with your local inspection authority before proceeding.

Therefore, a generator and feeder rated at 7.2kW would be required. Please note that the manufacturer’s generator loading factor should be considered when sizing the unit.
Load calculation for a complete single family dwelling

<table>
<thead>
<tr>
<th>BASIC</th>
<th>5000</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANGE</td>
<td>6000</td>
</tr>
<tr>
<td>OTHER LOADS @ 25%</td>
<td></td>
</tr>
<tr>
<td>HWT</td>
<td>4500W x 25%</td>
</tr>
<tr>
<td>Dryer</td>
<td>5000W x 25%</td>
</tr>
<tr>
<td>Hot Tubs</td>
<td>5000W x 100%</td>
</tr>
<tr>
<td>BB Heat</td>
<td>9000W x 100%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27375W</strong></td>
</tr>
</tbody>
</table>

@ 240V = 114A

- Service size installed: 200A
- Transfer switch to be sized to service: 200A
- Generator sized to calculated load: 27.4kW

Sample Loading Guide:

<table>
<thead>
<tr>
<th>Running Watts (Rated)</th>
<th>Starting Watts (Peak)</th>
<th>Running Watts (Rated)</th>
<th>Starting Watts (Peak)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling Fan 800</td>
<td>1200</td>
<td>Microwave Oven 1000W</td>
<td>1000</td>
</tr>
<tr>
<td>Central AC - 10,000 BTU</td>
<td>500</td>
<td>Table Saw - 10&quot;</td>
<td>1500</td>
</tr>
<tr>
<td>Central AC - 24,000 BTU</td>
<td>3000</td>
<td>Oscillating Fan</td>
<td>200</td>
</tr>
<tr>
<td>Circular Saw - 7 1/4&quot;</td>
<td>1400</td>
<td>Quartz Halogen Work Light</td>
<td>1000</td>
</tr>
<tr>
<td>Clothes Dryer - Gas</td>
<td>700</td>
<td>Refrigerator/Freezer</td>
<td>700</td>
</tr>
<tr>
<td>Coffee Maker</td>
<td>1500</td>
<td>Space heater</td>
<td>1000</td>
</tr>
<tr>
<td>Computer - 17&quot; Monitor</td>
<td>800</td>
<td>Stereo Receiver</td>
<td>450</td>
</tr>
<tr>
<td>Deep Freezer</td>
<td>700</td>
<td>Sump Pump</td>
<td>800</td>
</tr>
<tr>
<td>Dishwasher - Hot Dry</td>
<td>1500</td>
<td>Table Fan - 14&quot;</td>
<td>200</td>
</tr>
<tr>
<td>Electric Water Heater - 40 Gallon*</td>
<td>4000</td>
<td>Television - 21&quot;</td>
<td>500</td>
</tr>
<tr>
<td>Fax Machine</td>
<td>65</td>
<td>Water Well Pump - 1/3 HP (220V)*</td>
<td>1000</td>
</tr>
<tr>
<td>Furnace Fan</td>
<td>800</td>
<td>Window AC - 10,000 BTU</td>
<td>1200</td>
</tr>
<tr>
<td>Garage Door Opener</td>
<td>750</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Commercial standby example

<table>
<thead>
<tr>
<th>Circuit Description</th>
<th>Load (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressor circuit 8A @ 240V</td>
<td>1920</td>
</tr>
<tr>
<td>Cooler circuit (hard wired) 10A @ 120V</td>
<td>1200</td>
</tr>
<tr>
<td>2 general lighting circuits 2 x 12A @ 120V (general use outlets)</td>
<td>2880</td>
</tr>
<tr>
<td>1 circuit supplying cash registers 6 plugs 6A @ 120V (fixed load)</td>
<td>720</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6720W</strong></td>
</tr>
</tbody>
</table>

6720 x 1.25 = 8400W

Therefore, a generator and feeder rated at 8.4kW is required.

**Note: Rule 8 - 104(3)** indicates that in this type of occupancy, the load is considered to be continuous.

As the Code considers commercial loads as being continuous, the calculated load of 6720W is multiplied by 125% to determine minimum generator and circuit sizing

6720 x 1.25 = 8400W

Therefore, a generator and feeder rated at 8.4kW would be required.

**Generator Loading Summary**

Generator must be sized to the load
- Calculated or connected
- Sized to allow motor starting
  - Add 20%
  - Or use running and peak ratings

Automatic load shedding permitted
- Must automatically shed loads to stay within generator load rating

Manual load shedding is not permitted for residential installations.

Manual load shedding may be permitted for commercial installations if an operating permit is in place.
Where an electrical operating permit is held for the installation, the following terms and conditions apply for manual load shedding at commercial and industrial sites:

- A suitable training program is developed and provided to those employees authorized to perform the manual load shedding
- Clear written instructions are posted at the stand-by power location
- The load transfer is by manual operation
- Manual load shedding will be acceptable for commercial and industrial sites only

**Emergency standby systems**

*Rule 46 - 100* states that emergency systems and unit equipment shall have adequate capacity and rating to ensure the satisfactory operation of all connected equipment when the principal source of power fails. These required systems are specifically designed for the particular facility for which they are intended to protect against power failure. Do not add load to these systems without first doing a thorough analysis.

**Canadian Electrical Code**  
**Rule 46 - 100**  
**Capacity**  

*Emergency power supply and unit equipment shall have adequate capacity and rating to ensure the satisfactory operation of all connected equipment when the principal source of power fails.*

**TRANSFER SWITCHES**

**Designing the transfer system**

- What does the generator supply?
- Emergency loads (hospitals, fire pumps, fire alarm, etc.)
- Non-emergency loads (not life safety systems)

**Emergency loads**

**Hospitals and other health care facilities**

Designed by and specified by an electrical consultant. Electrical contractors should be aware of the following requirements:

- *Rule 24 - 304, CSA C22.2 No. 178,* and *CSA Z32-09*
  - Requirements for speed of transfer for vital and delayed vital circuits and circuits that are to be automatically transferred
  - Conditional branch may be automatic or manual transfer
Emergency power for building life safety systems:
- Covered in detail by the building code and CSA C282-09
- Must be automatic
- May require protected feeders if the requirement for high buildings is applicable
- Will have min. running time requirements that will dictate the amount of fuel stored on site

This standard will be part of any good emergency supply design.

Other transfer systems (not life safety systems)

Residential or commercial standby systems:
- No regulatory requirements for type of transfer scheme
- Client determines requirement for either manual or automatic transfer
  - Depends on cost and type of generator installed
- Building Code and BCEC Section 46 do not apply

Transfer methods
- Automatic transfer switches
- Manual transfer switches
- Panel type transfer arrangement
- Other types of transfer schemes

Transfer switch sizing
- Transfer switch rating must equal the main service ampacity if supplying the main service.
- Transfer switch rating must equal the connected load and generator rating when supplying a feeder.
- This example is okay for residential applications
- For Commercial Loads minimum size required is 8.2kW
  \[27.1A \times 125\% = 33.8A \text{ (In practice 40A)}\]
Obtaining Control Power for Auto Start Generators

- Auto start generators require a sensing (control) circuit for start-up purposes
- May be factory supplied or field wiring supplied
- If field wired, the sensing circuit may be obtained from any suitable circuit supplied by the main service panel
- Installation must be compliant with the Code
- The disconnect for the control circuit must be accessible with clear working space as per Rules 2 - 308 & 28 - 604

Rule 14 - 414 Control power disconnect requirements

Rule 14 - 414 requires a local disconnecting means to disconnect the control power while working on the unit. This requirement is meant to protect an operator or maintenance person from a shock hazard. Always refer to the Manufacturer’s Installation Instructions as the design of the unit may already comply with Rule 14 - 414(2) in which case a supplemental disconnecting means is not required.

Wiring methods and equipment type shall be acceptable for the environment and location (Type 3R switch on wall).

Canadian Electrical Code
Rule 14 - 414
Connection to different circuits

(1) Where electrical equipment is supplied by two or more different transformers or other different sources of voltage, then

(a) a single disconnecting means that will effectively isolate all ungrounded conductors supplying the equipment shall be provided integral with or adjacent to the equipment; or

(b) each supply circuit shall be provided with a disconnecting means integral with or adjacent to the equipment, and the disconnecting means shall be grouped together.

(2) Notwithstanding Subrule (1), disconnecting means integral with or adjacent to equipment need not be provided for control circuits originating beyond the equipment and not exceeding 150 volts-to-ground, provided that all associated bare live parts are protected against inadvertent contact by means of barriers.
(3) Where multiple disconnecting means as in Subrule (1)(b) are provided, suitable warning signs shall be placed on or adjacent to each disconnecting means so that all of the disconnecting means must be opened to ensure complete de-energization of the equipment.

(4) Where barriers are used as required in Subrule (2), a suitable warning sign shall be placed on or adjacent to the equipment, or on the barriers, indicating that there is more than one source of supply to the equipment.

Manual transfer switches

- Generally used for portable generators
- Can be used with automatic start or remote start generators
- 2 basic types:
  - Switch type
  - Dual breaker type

Transfer switch - dual breaker type diagram
Normal hydro operation diagram

Generator operation diagram

NOTE: Neutral conductors shown in yellow
GROUNDING AND BONDING

Grounding of generators

When to install a ground electrode

Canadian Electrical Code
Rule 10 – 106
Alternating-current systems

(1) Except as otherwise provided for in this Code, alternating-current systems shall be grounded if
   (a) by so doing, their maximum voltage-to-ground does not exceed 150 V; or
   (b) the system incorporates a neutral conductor.

(2) Wiring systems supplied by an ungrounded supply shall be equipped with a suitable ground detection device to indicate the presence of a ground fault.
Canadian Electrical Code
Rule 10 - 204
Grounding connections for alternating-current systems

(1) When a consumer’s service is supplied by an alternating-current system that is required to be grounded in accordance with Rule 10-106(1), the system shall

(a) be connected to a grounding conductor at the transformer or other source of supply;

(b) be connected to a grounding conductor at each individual service, with the connection made on the supply side of the service disconnecting means either in the service box or in other service equipment; and

(c) except as provided for in Rule 10-208, have no connection between the grounded circuit conductor on the load side of the service disconnecting means and the grounding electrode.

(2) Where the system is grounded at any point, the grounded conductor shall

(a) be run to each individual service;

(b) have a minimum size as specified for bonding conductors in Table 16;

(c) also comply with Rule 4-022 where it serves as the neutral; and

(d) be included in each parallel run where the service conductors are run in parallel.

(3) Notwithstanding Rule 12-108, the size of the system grounded conductors in each parallel run shall be permitted to be smaller than No. 1/0 AWG.

Canadian Electrical Code
Rule – 206
Grounding connections for different systems at a facility

(1) Where, in addition to the system supplying the consumer’s service as described in Rule 10-204, one or more different systems conforming to Rule 10-106(1) exist at a facility,

(a) each different system shall be connected to a separate grounding conductor

   (i) at the transformer or other source of supply; or

   (ii) at the first switch controlling the system.
(2) Notwithstanding Subrule (1), where the conductor to be grounded from each of two such systems terminates at a common tie point, a single connection to a grounding conductor shall be permitted to be made

(a) at the tie point; or

(b) at the service equipment if one of the systems supplies the consumer’s service.

(3) Notwithstanding Rules 10 - 802 and 10 - 806, where a circuit is required to be grounded and is supplied from a source having a rated output of 1000 V•A or less, the grounding connection shall be permitted to be made to

(a) the metal enclosure of the power supply, provided that the enclosure is connected to a bonding conductor; or

(b) the bonding conductor within the enclosure.

Canadian Electrical Code
Rule 10 – 702
Spacing and interconnection of grounding electrodes

Where multiple grounding electrodes exist at a building, including those used for signal circuits, radio, lightning protection, communication, community antenna distribution systems or any other purpose, they shall be

(a) separated by at least 2 m from each other;

(b) bonded together with not less than a No. 6 AWG copper conductor protected by location from mechanical injury; and

(c) in the case of lightning protection systems, bonded together in accordance with Item (b) at or below ground level

Grounding Permanent Installed Generator - “Floating Neutral” vs. “Bonded Neutral”

1. The grounding requirements depend on how the generator neutral is installed.

2. Always check the generator’s specification sheet or manufacturer’s installation instructions

3. The type of transfer switching depends on how the generator neutral is installed

4. “Floating” neutral type = Un-switched Neutral in Transfer Switch and no separate system ground

5. “Bonded” neutral type = switched neutral in transfer switch, separate system ground, bonded to Hydro system ground as per Rule 10 - 702 OR

6. Change the neutral connection to match the transfer switch arrangements BUT confirm with manufacturer’s instructions.
Permanent Installations, Floating Neutral Generators

2 pole transfer switch, Neutral is not switched. Grounding is approved. The neutral is not double bonded.
Permanent Installations, Bonded Neutral Generators

3 pole transfer switch used and Neutral is switched. Grounding is approved. The Generator neutral is not double bonded.
Portable generator grounding

If neutral is bonded to frame, then neutral should be switched and generator neutral provided with ground electrode where the generator is used solely for connection to the transfer switch.
Most residential installations use portable generators with neutrals bonded to their metal frames. This is a common installation and creates numerous code and safety issues:

1. Leaving Generator Set bonding between Neutral and frame as is will result in double bond condition when 2 pole transfer switches used which violates Rule 10-204 (unswitched neutral).

2. Modifying Generator Set by isolating the Neutral from the frame could result in shock hazard when Generator used for other purposes which violates Rules 10-106 & 10-400.

3. Modifying Generator Set by isolating the Neutral from the frame will result in an ungrounded Neutral when 3 pole transfer switches used which violates Rule 10-106 (switched neutral).

4. If Generator Set requires grounding to an electrode before its use, how can we ensure the User will make this physical connection prior to using it?

5. Should we only require a label by the transfer switch stating “Floating Neutral Only” or “Bonded Neutral Only” as some jurisdictions do?

Solution – portable generators used for multi-purposes

- Accept portable generators with “bonded” or “floating” (isolated) neutrals for standby use
- Use 2 pole transfer panels and make solid neutral connections only
- If 3 pole transfer switch is supplied,
  - Replace with a 2 pole transfer switch (Preferred)
  - Reconfigure the switch to a 2 pole solid neutral connection as shown below (Acceptable)
- It is recommended the generator neutral not be re-configured as this introduces other hazards when the generator is used for other purposes
2 pole generator panels systems

These panels come with factory installed solid neutral connections.

Modifications are not required and are approved for portable generator transfer.

Typical 3 Pole Switched Neutral Transfer Panel
GENERATOR WIRING METHODS

Permanent standby systems

Between the transfer switch/transfer panel to the generator location:

- Use Section 12 wiring method approved for the location (i.e. NMD90, AC90, Teck90, ACWU90)
- Electrical wiring exposed to the weather must be approved for the location
- Flexible cable (Cab Tire type) is not approved as permanent interior building wiring but is okay for the connection of portable equipment
Portable generator wiring methods

Between the transfer panel and building exterior:
- Any Section 12 wiring method approved for the location (i.e. NMD90, AC90, Teck90, ACWU90)
- Terminate in Panel Mount type receptacle

Between the generator outlet and the portable generator supply cable:
- Panel mount type receptacle (must be a ‘male’ receptacle) in an acceptable location as per generator rating
- Flexible cord (extra hard usage) with male end for connection at the generator outlet and female end to connect to panel mount type receptacle
- Cord to be sized from Table 12 and voltage drop must be considered
- Flexible cord shall not to be used to replace permanent wiring

Canadian Electrical Code
Rule 4 – 010 (3)
Uses of flexible cord

(3) Flexible cord shall not be used

(a) as a substitute for the fixed wiring of structures and shall not be
   (i) permanently secured to any structural member;
   (ii) run through holes in walls, ceilings, or floors; or
   (iii) run through doorways, windows, or similar openings;

(b) at temperatures above the temperature rating of the cord or at temperatures sufficiently low as to be liable to result in damage to the insulation or overall covering; and

(c) for the suspension of any device weighing more than 2.3 kg, unless the cord and device assembly are marked as capable of supporting a weight up to 11 kg.
Panel mount receptacles

Typical connection for portable generators up to 12kW:

- Male panel mount receptacles enclosed in a NEMA-3R and weatherproof boxes.
- 4 wire twist lock inlet 120/240 Volt, 4 wire
- CSA Approved as Type 3R
- Available in two sizes: 30A and 50A

Non Compliant Installation

The installation in Figure 1 is NOT Compliant. The splicing is done inside the existing panel.
Code infraction #1

Canadian Electrical Code
Rule 6 – 212
Wiring space in enclosures

(1) Enclosures for circuit breakers and externally operated switches shall not be used as junction boxes, troughs, or raceways for conductors feeding through or tapping off to other apparatus.

(2) Notwithstanding Subrule (1), service equipment specifically designed for accommodating current monitoring devices shall be permitted.
Connection to different circuits.

(1) Where electrical equipment is supplied by two or more different transformers or other different sources of voltage, then

   (a) a single disconnecting means that will effectively isolate all ungrounded conductors supplying the equipment shall be provided integral with or adjacent to the equipment; or

   (b) each supply circuit shall be provided with a disconnecting means integral with or adjacent to the equipment, and the disconnecting means shall be grouped together.

(2) Notwithstanding Subrule (1), disconnecting means integral with or adjacent to equipment need not be provided for control circuits originating beyond the equipment and not exceeding 150 volts-to-ground, provided that all associated bare live parts are protected against inadvertent contact by means of barriers.

(3) Where multiple disconnecting means as in Subrule (1)(b) are provided, suitable warning signs shall be placed on or adjacent to each disconnecting means so that all of the disconnecting means must be opened to ensure complete de-energization of the equipment.

(4) Where barriers are used as required in Subrule (2), a suitable warning sign shall be placed on or adjacent to the equipment, or on the barriers, indicating that there is more than one source of supply to the equipment.
(1) Enclosures for overcurrent devices, controllers, and externally operated switches shall not be used as junction boxes, troughs, or raceways for conductors feeding through to other apparatus.

(2) Notwithstanding Subrule (1),

(a) the enclosures identified shall be permitted to be used as junction boxes

   (i) for all installations where a single feeder supplying another enclosure is tapped from it and the connectors used each provide an independent clamping means for each conductor and each clamping means is independently accessible for tightening or inspection; or

   (ii) where wiring is being added to an enclosure forming part of an existing installation and the conductors, splices, and taps do not fill the wiring space at any cross-section to more than 75% of the cross-sectional area of the space; and

(b) the enclosure identified may be used as a raceway where the conductors are being added to enclosures forming part of an existing installation and all conductors present do not fill the wiring space at any cross-section to more than 40% of the cross-sectional area of the space.

(3) Conductors entering enclosures shall enter such enclosures as near as practicable to their terminal fittings.

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This installation is compliant with the BC Electrical Code. The umbilical tail enters a separate junction box as does the branch circuits pulled out of the main panel board. No conductors will be energized in the main panel when the generator is running. Only the transfer switch is supplied from two sources at any one time.