STANDATA variance 21-ECV-064-900-ESS/19-BCB-010

Electrical/Building

2021 Canadian Electrical Code, Part I, Section 64

Date Issued: April 2023

Purpose

Industry has identified concerns regarding Energy Storage System (ESS) requirements. This variance permits the installation of an ESS at a dwelling unit or residential occupancy not exceeding 20 kWh for any single ESS, as an alternative method to the C22.1:21 – Canadian Electrical Code, Part I.

Discussion

The current electrical code, C22.1:21 – Canadian Electrical Code, Part I, Rule 64-918 2) prohibits the installation of ESS's utilizing batteries below grade, including basements of dwelling units. Additionally, 64-918 4) prohibits ESS's with a storage capacity above 1 kWh from being installed in a dwelling unit or living space of a residential occupancy including clothes closets, storage rooms, bathrooms, stairways, or in any similar undesirable locations.

The next electrical code is C22.1:24 – Canadian Electrical Code, Part I, and will contain requirements for ESS installations up to 20 kWh for any single ESS installed at a dwelling unit or residential occupancy.

The upcoming code provisions in the 2024 edition are developed by the CSA Group. Additional standards related to ESS's include:

- Batteries for Use in Stationary and Motive Auxiliary Power Applications UL1973, which covers battery safety,
- Energy Storage Systems and Equipment UL9540, which covers overall ESS system safety,
- ANSI/CAN/UL Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems UL9540A, which covers fire propagation testing, and
- The Standard for the Installation of Stationary Energy Storage Systems NFPA 855, which covers construction, separation, operation, maintenance, and commissioning of ESS's.

Unless stated otherwise, all Code references in this STANDATA are to the Canadian Electrical Code, Part I 2021

Issued by the Provincial Electrical and Building Administrators

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These standards allow the potential for ESS's to be installed at a dwelling unit or residential occupancy. The UL1973, UL9540 and Standard for the Installation of Stationary Energy Storage Systems NFPA 855 have improved significantly allowing for testing of ESS's for residential use and provide better fire protection. Provisions also include requirements for fire protection to mitigate thermal runaway.

The C22.1:24 – Canadian Electrical Code, Part I, is anticipated to be published in 2024 and coming into force approximately 12 months from its publication date, with minimal provincial variations. In order to advance the installation of ESS's in Alberta, this variance will permit ESS's up to 20 kWh for any single ESS at a dwelling unit or residential occupancy anywhere in Alberta - provided it complies with the conditions in this variance. A variance provides an alternative solution of approximately equivalent or greater safety performance to the prescriptive requirements of the codes. Any ESS installation that complies with this variance is permitted just as if the installation was installed under code requirements.

Variance under the Safety Codes Act

The conditions in this variance are based on the unpublished code provisions in the upcoming C22.1:24 – Canadian Electrical Code, Part I. When this edition is adopted and brought into force in Alberta, the requirements for ESS's will essentially be unchanged when compared to this variance. Any ESS installation under this variance will be allowed to continue under the conditions in this variance until the next C22.1:24 – Canadian Electrical Code, Part I is adopted and comes into force in Alberta.

Current installation

C22.1:21 – Canadian Electrical Code, Part I, rule 64-918 currently does not permit an ESS with a storage capacity greater than 1kWh or utilizing lithium-ion batteries in dwelling units and any living space of a residential occupancy. The provisions in C22.1:21 – Canadian Electrical Code, Part I, severely restrict the installation of ESS's at dwelling unit or residential occupancy.

The current C22.1:21 – Canadian Electrical Code, Part I also states ESS's utilizing batteries shall be permitted to be installed in an electrical equipment vault and an Appendix B note suggests alternative locations may be considered subject to discussions with the local building, fire or appropriate authority having jurisdiction (AHJ). Even with equipment in conformance to UL 9540, UL 90540A standard, the location, size and spacing should still have a standard set of restrictions. The main purpose of these restrictions would be to ensure the occupants have adequate time and points of egress to exit the premises if there was a fire. Systems that are manufactured and certified for Canadian residential use and tested to UL9540, UL9540A exist, which until recently was not the case.

Code References

Third Memorandum of Revisions to CSA C22.1:21

Section 64 Renewable energy systems, energy production systems, energy storage systems, and batteries

64-000 Scope (see Appendix B)

1) This Section applies to the installation of renewable energy systems, energy production systems, energy storage systems, and batteries except where the voltage and current are limited in accordance with Rule 16-200 1) a) and b)
2) This Section supplements or amends the general requirements of this code. Batteries shall be installed in accordance with the provisions of Rules 64-802 to 64-814, except as otherwise required by the manufacturer.

Definitions

Energy storage system —a system capable of storing energy, and supplying electrical energy to local power loads, or operating in parallel with a supply authority system or any other power sources.

Field-assembled energy storage system —Equipment assembled in the field to form an energy storage system.

Residential use energy storage system—an energy storage system that

a) conforms to the requirements of UL 9540; and
b) has a capacity not exceeding 20 kWh for any single energy storage unit.

Self-contained energy storage system —equipment manufactured as a single unit to form an energy storage system.

Installation of batteries

64-800 Scope

1) Batteries shall be installed in accordance with the provisions of Rules 64-802 to 64-814, except as otherwise required by the manufacturer.
2) Electrical equipment associated with batteries shall be installed in accordance with the provisions of Rules 64-816 to 64-820.

64-802 Ventilation of battery rooms or areas (see Appendix B)

1) Rooms or areas that contain batteries that vent hydrogen to the atmosphere shall be adequately ventilated.
2) Lead-acid batteries shall not be subjected to ambient temperatures greater than 45 °C or less than the freezing point of the electrolyte.

64-804 Installation (see Appendix B)

1) Batteries shall be suitable for the purpose.
2) Batteries with exposed energized parts shall be kept in a room or enclosure accessible only to authorized personnel.
3) Batteries installed in a dwelling unit shall be connected with an output voltage not exceeding 50 V dc.
4) Energized parts of batteries installed in dwelling units shall be guarded to prevent accidental contact by persons or objects, regardless of voltage or battery type.
5) Battery trays, racks, and other surfaces on which batteries are mounted shall be
   a) level;
   b) protected against corrosion from the battery electrolyte, if corrosive;
   c) covered with an insulating material having a dielectric strength of at least 1500 V;
   d) of sufficient strength to carry the weight of the batteries; and
   e) designed to withstand vibration and sway where appropriate.
6) Batteries shall be spaced in accordance with the manufacturer's installation instructions.
7) For lead-acid type batteries, no conductive materials shall be located within 150 mm of the tops of the non-conductive cases.

64-806 Current-limiting overcurrent devices (see Appendix B)

A current-limiting overcurrent device shall be installed in each battery circuit where the available short-circuit current from a battery or battery bank exceeds the short-circuit current ratings of other equipment in that circuit.

64-808 Disconnection of series battery circuits

Battery circuits subject to field servicing, operating at more than 50 V dc shall have provisions for disconnecting the

a) series-connected strings; and
b) grounded circuit conductor(s) in the battery electrical system for maintenance without disconnecting the grounded circuit conductor(s) of other circuits in the system.

64-810 Bonding of battery installations

Bonding of battery installations shall be in accordance with Section 10 in the C22.1:21 – Canadian Electrical Code, Part I.

64-812 Battery interconnections (see Appendix B)

1) Insulated conductors and cables used to terminate to battery terminals shall be of the flexible fine strand type.
2) The connection method between batteries shall be permitted to be insulated or bare busbars.
3) Flexible metal raceways shall not be permitted for battery interconnections
4) Conductors shall have sufficient ampacity for the maximum load.
5) Insulated flexible conductor and cable terminations to a battery terminal or associated equipment, as well as interconnections between battery strings, shall be secured to minimize the movement of cables due to short-circuit forces and at intervals not more than 1.5 m throughout the run.

64-814 Wiring from batteries to other equipment

1) Conductors for connection from battery terminals to other equipment shall
   a) be installed in accordance with Rule 64-812;
   b) be sized in accordance with the load but not less than 2/0 AWG; and
   c) extend not less than 300 mm from battery terminals.
2) Conductors that extend more than 3 m from battery terminals shall be
   d) a) in a wiring method in accordance with Section 12; and
   e) b) in accordance with Rule 14-100 b).
3) For batteries containing corrosive electrolyte, insulated conductors between batteries and other equipment shall be permitted to be installed in a raceway, provided the raceway
   a) is of corrosion-resistant material or other materials suitably protected from corrosion;
   b) is tightly sealed with sealing compound, rubber tape, or other material to resist the entrance of electrolyte by spray or creeping;
   c) has an insulating bushing where the conductor emerges for connection to the battery, or be a non-metallic raceway with a suitable fitting; and
   d) is located at least 300 mm above the highest battery terminal to reduce electrolyte creepage or spillage entering the raceway.
4) Flexible metal raceways shall not be permitted to connect batteries to other equipment.
5) For batteries containing corrosive electrolyte, cable shall be permitted to be installed for connection to other equipment provided
   a) he cable is of corrosion-resistant material or other materials suitably protected from corrosion;
   b) the end of the cable is tightly sealed with sealing compound, rubber tape, or other material to resist the entrance of electrolyte by spray or creeping;
   c) the conductor issues from a cable through an insulating bushing or inner jacket where a metal armoured cable is used;
   d) at least 300 mm of free conductor extends from the cable where connected to a battery terminal; and
   e) the cable exit is located at least 300 mm above the highest battery terminal to reduce electrolyte creepage or spillage entering the raceway.

64-816 Wiring methods and installation of equipment in battery rooms

The installation of wiring and equipment in a battery room, which is not part of the wiring of the batteries, shall be in accordance with the requirements for an ordinary location.

64-818 Charge control (see Appendix B)

1) Equipment shall be provided to control the charging process of the batteries.
2) Notwithstanding Subrule 1), charge controller equipment shall not be required where the design of the renewable energy source circuit is the only supply and is matched to the voltage rating and charge current requirements of the interconnected battery cells, and the maximum charging current multiplied by 1 h is less than 3% of the rated battery capacity.
3) All adjusting means for control of the charging process shall be accessible only to qualified persons.

64-820 Diversion charge controller (see Appendix B)

1) Systems employing a diversion charge controller as the sole means of regulating the charging of a battery shall be equipped with an additional, independent means to prevent overcharging of the battery.
2) Circuits containing a dc diversion charge controller and a dc diversion load shall comply with the following:
   a) the current rating of the diversion load shall be less than or equal to the current rating of the diversion load charge controller;
   b) the voltage rating of the diversion load shall be equal to or greater than the maximum battery voltage;
   c) the power rating of a diversion load shall be at least 150% of the power rating of the charging source; and
   d) the conductor ampacity and the rating of the overcurrent device for the circuit shall be at least 150% of the maximum current rating of the diversion charge controller.
3) Renewable energy systems using interactive inverters to control battery state-of-charge by diverting excess power into the utility system shall have an additional, independent means of controlling the battery charging process for use when the utility is not present or when the primary charge controller fails or is disabled.

Energy storage systems
General

64-900 Scope (see Appendix B)

Rules 64-902 to 64-926 apply to the installation of self-contained and field-assembled energy storage systems.

64-902 Marking (see Appendix B)

1) In addition to the requirements in Rule 64-074, a plaque or directory shall be provided to indicate the building or structure contains an energy storage system and the location of all energy storage system disconnecting means.
2) Energy storage systems with a storage capacity of 1 kWh or less, shall include permanent markings, as applicable to the system, in accordance with Rule 2-100 at a readily accessible location at the disconnecting means for the energy storage system.
3) Energy storage systems meeting the requirements of Rule 2-024 shall be deemed to meet the requirements of Subrule 2).

64-904 Voltage of energy storage systems

1) Energy storage systems installed in accordance with Rule 64-1100 shall
   a) not exceed 600 V; and
   b) have all energized parts over 150 volts-to-ground accessible only to qualified persons.
2) The dc portion of energy storage systems with maximum voltages higher than 750 V dc but not exceeding 1500 V dc shall not be required to comply with Rules 36-204, 36-208, and 36-214 provided that
   a) the installation is serviced only by qualified persons;
   b) the part of the installation exceeding 750 V dc is inaccessible to the public; and
   c) enclosures in which circuits exceeding 750 V dc are present are marked with the word “DANGER” followed by the maximum rated circuit voltage of the equipment.

64-906 Insulated conductors and cables

Insulated conductors and cables for interconnection and connection of energy storage systems shall have a temperature rating of not less than 90 °C.

64-908 Insulated conductors marking or colour coding

Insulated conductors for dc circuits shall be colour coded or marked as follows:

a) for a 2-wire circuit,

i) red for positive and black for negative;
ii) insulated conductors, other than green or white, with permanent marking at terminations and splices in accordance with Item i); or
iii) insulated conductors manufactured with permanent surface printing indicating the polarity on the insulated conductor; and

b) for a 3-wire circuit (bipolar circuit),
i) white or white with a coloured stripe for the mid-wire (identified as the centre tap), red for positive, and black for negative;
ii) insulated conductors, other than green or white, with permanent marking at terminations and splices in accordance with Item i); or
iii) insulated conductors manufactured with permanent surface printing indicating the polarity on the conductor insulation.

64-910 Installation and maintenance

1) Energy storage system equipment shall be installed and maintained in accordance with the manufacturer's instructions.
2) Mechanical protection shall be provided where an energy storage system is subject to the risk of vehicular impact or other physical damage.

64-912 Overcurrent protection

1) Where the available short-circuit current exceeds the ampacity of the conductor, each ungrounded conductor of an energy storage system shall be protected in accordance with Rules 14-100 and 14-104.
Equipment and conductors that are energized from both directions shall be provided with overcurrent protection from each source of supply in accordance with Subrule 1). Overcurrent devices used in any dc portion of an energy storage system shall be marked or the purpose.

64-914 Disconnecting means for energy storage systems (see Appendix B)

1) Disconnecting means for energy storage systems shall be in accordance with Subrules 2) to 8).
2) Where an energy storage system does not include an integral output disconnecting means, a disconnecting means shall be installed in accordance with Subrule 3).
3) The disconnecting means referenced in Subrule 2) shall
a) be capable of being energized from both sides;
b) indicate whether it is in the open or closed position;
c) have provision for being locked in the open position;
d) be in accordance with Section 14;
e) be capable of being opened at rated load;
f) be capable of being closed with a fault on the system; and
g) be located within sight of and within 9 m of the energy storage system equipment
4) The disconnecting means required by this Rule shall not be connected in any grounded conductor if operation of that disconnecting means would cause the grounded conductor to be in an ungrounded and energized state.
5) The disconnecting means shall comply with Rules 14-414 and 14-700.
6) As required by Rule 14-402, disconnecting means shall be provided to disconnect a fuse from all sources of supply if the fuse is energized from both directions, unless the fuse can be readily and safely de-energized.
7) Disconnecting means provided on dc circuits shall be rated for dc applications.
8) The disconnecting means shall bear a warning to the effect that the terminals on both the line and load sides could be energized when the disconnecting means is open.

64-916 Bonding (see Appendix B)

1) Non-current-carrying conductive parts of electrical equipment shall be bonded in accordance with Section 10.
2) In addition to the bonding requirements of Section 10, metal objects such as battery racking, cable management systems, structures and enclosures housing field-assembled energy storage

equipment, etc., shall be made electrically continuous and bonded to non-current-carrying conductive parts of electrical equipment.

3) Bonding conductors shall be sized in accordance with Section 10 based on the largest overcurrent device protecting the circuit conductors.

64-918 Diversion load controllers

A diversion load controller used as the primary means of regulating the stored kinetic energy of an energy storage system shall not use the supply authority system as a diversion load.

64-920 Ampere rating of energy storage system circuits

1) The current rating for energy storage system circuits shall be as follows:
   a) the rated current indicated on the energy storage system nameplate(s),
   b) for an inverter output circuit, the inverter continuous output current rating;
   c) for an inverter input circuit, the continuous inverter input current rating when the inverter is producing rated power at the lowest input voltage;
   d) for the output of a dc-to-dc converter, the dc-to-dc converter continuous output current rating; and
   e) for a charge controller, the input current rating while charging
2) Where interconnected with the supply authority system, the current rating referred to in Subrule 1) shall be considered a continuous load for the application of Rule 8-104.
3) Where the output supplies dedicated loads or other power systems, the continuous load shall be determined in accordance with Rule 8-104 3).

64-922 System charge control (see Appendix B)

1) Equipment shall be provided to control the charging process of an energy storage system.
2) Adjustable settings for control of the charging process shall be accessible only to qualified personnel.
3) A diversion charge controller installed as part of an energy storage system shall be in accordance with the requirements of Rule 64-820.
4) A self-contained energy storage system shall be deemed to meet the requirements of this Rule.

64-924 Working space and accessibility to energized parts (See Appendix B)

1) Notwithstanding Rule 2-308, 2-310 and 2-312,working space requirements within energy storage systems complying with Rule 2-024 1) shall be permitted to be in accordance with the manufacturers instructions.
2) Energy storage systems installed in dwelling units shall have no exposed energized parts.

64-926 Egress from buildings

Except as provided for by other rules of this Code, batteries forming part of an energy storage system located outdoors shall not impede egress from a building and shall not be located closer than 3 m from

a) a means of egress; and
b) entrance or exit doors.

Energy storage systems utilizing batteries

General

64-1000 Scope

Rule 64-1002 to 64-1004 apply to the installation of energy storage systems utilizing batteries with a storage capacity exceeding 1 kWh.

64-1002 Installation requirements of energy storage systems

1) Energy storage systems utilizing batteries shall comply with Rule 2-024 1), and be installed and assembled in accordance with the manufacturer's instructions.
2) Except where installed in an electrical equipment vault, energy storage systems utilizing batteries shall not be installed where the floor is

a) higher than 23 m above grade; or
b) below the lowest level of egress from the occupancy.

3) Energy storage systems shall be installed in accordance with Rule 2-328

64-1004 Installation requirements of batteries forming part of an energy storage system

1) Batteries forming part of an energy storage system shall
   a) be installed in accordance with the manufacturer's installation instructions where provided; or
   b) be installed in accordance with Rules 64-800 to 64-820.
2) Notwithstanding Rule 64-804 3), where indicated in the manufacturers installation instructions, batteries forming part of energy storage system installed in a dwelling unit, shall be permitted to be connected to exceed 50 V dc.

Installation of energy storage systems at residential occupancies

64-1100 Location and separation requirements (See Appendix B)

1) Energy storage systems installed at a dwelling unit or residential occupancy shall be suitable for residential use, and be located.
   a) in an attached garage,
   b) in or on an associated detached garage, or other free standing structure,
   c) on the exterior surface of a dwelling unit or residential occupancy,
   d) in a dedicated room with a fire resistance rating of not less than 1 h when installed in a dwelling unit or residential occupancy, or
   e) in other locations where permitted
2) Notwithstanding Rule 64-1002 2) b), energy storage systems in a dwelling unit or residential occupancy shall be permitted to be installed below the lowest level of egress when located in accordance with Subrule 1) d) or e).
3) Energy storage systems shall not be installed in sleeping areas, or rooms opening directly into sleeping areas.
4) Except as required by Subrule 5), energy storage systems installed in accordance with Subrule 1), shall
   a) have a storage capacity not exceeding 20 kWh for any single energy storage system; or
   b) where multiple energy storage systems are installed, have an aggregate capacity not exceeding 80 kWh.
5) Energy storage systems installed in accordance with Subrule 1) d) shall
   a) have a storage capacity not exceeding 20 kWh for any single energy storage system; or
   b) where multiple energy storage systems are installed, have an aggregate capacity not exceeding 40 kWh.
6) Batteries forming part of an energy storage system installed outdoors shall not be located within 1 m of any window or door of a dwelling unit or residential occupancy.
7) Where multiple energy storage systems are installed, batteries forming part of each system shall be spaced not less than 1 m apart from each other.
8) Notwithstanding Subrules 1) through 7), energy storage systems evaluated to UL9540A shall be permitted to be installed in accordance with the manufacturer's installation instructions.
9) Where an energy storage system is installed in a dwelling unit or residential occupancy, a smoke alarm or smoke detector shall be installed,
   a) in the area or room where the energy storage system is located, and,
   b) be connected in accordance with Section 32.

Appendix B informative Notes

Rule 64-002

Energy storage system
Additional information regarding energy storage systems is located in UL 9540.

This definition is not intended to include an uninterruptible power system (UPS) which is covered by CSA C22.2 No. 107.3.

CSA C22.2 No. 107.3 defines an uninterruptible power system as follows:

Uninterruptible power system (UPS)

combination of converters, switches, and energy storage devices (such as batteries), constituting a power system for maintaining continuity of power to a load in case of input power failure.

Field-assembled energy storage systems

Field-assembled energy storage systems involve interconnection of separate pieces of equipment forming an overall energy storage system. This equipment may include batteries, protection, control, power conversion, charge control, and fire detection.

64-800

The intent of this Rule is to provide direction to Code users when components, such as batteries, inverters, converters, and controls, are interconnected in the field to create an energy storage system and have not been evaluated together as an assembly in accordance with UL 9540

64-802

Sufficient ventilation should be provided to prevent the hydrogen gas from building up to a level of 2% by volume in the room air at any time. When batteries are operated in constant-voltage-float service and the float voltage is maintained at appropriate levels, generation of gas is very slight. The rate of ventilation required to maintain the volume of hydrogen gas below the 2% level in a battery room may be calculated in accordance with IEEE 484. As an example, the volume of hydrogen gas generated daily by a 60 cell, 840 ampere-hour lead calcium grid battery charging at 2.2 V per cell is determined as follows:

Total m3/min of hydrogen gas = number of cells × gas generation rate of battery type in m3/min × float current in amperes × minutes/day.

$$\text{Volume of gas production} = 60 \text{ cells} \times 7.6 \times 10^{-6} \frac{\text{m}^3}{\text{min}} \times \frac{0.006 \text{ A}}{100 \text{ A.H.}} \times 840 \text{ A.H.} \times \frac{60 \text{ min}}{\text{h}} \times \frac{24 \text{ h}}{\text{day}}$$

$$= \frac{0.03309 \text{ m}^3 \text{ gas}}{\text{day}}$$

For a room volume of 30 m3, the total volume of gas that should be allowed to accumulate in this room is 30 m3 × 2% = 0.6 m3.

Therefore, to meet this 2% maximum level, one air change is required for each

$$\frac{0.6 \text{ m}^3}{0.03309 \text{ m}^3 \frac{\text{gas}}{\text{day}}} = 18 \text{ days}$$

However, a minimum of one to four air changes per hour in the battery room is recommended to prevent pockets of hydrogen gas from accumulating and to ensure the comfort of the maintenance personnel.

Rule 64-802 2)

The freezing point of the electrolyte used in a lead-acid battery is –15 °C for a specific gravity of 1.150, –20 °C for a specific gravity of 1.175, and –27 °C for a specific gravity of 1.200. The freezing point will be higher if the battery is completely discharged. Therefore, batteries should not be located in areas where the temperature is likely to fall below –7 °C.

Rule 64-804

Metal trays and cases or containers in flooded, lead-acid battery systems operating over 50 V dc have been shown to be a contributing factor in ground faults. Non-conductive racks, trays, and cases minimize this problem.

Rule 64-804 1)
The Standards for batteries are UL 1973 and UL 9540.

Rule 64-804 4)
Batteries can be subject to extensive charge/discharge cycles and typically require frequent maintenance (e.g., checking electrolyte, cleaning connections). At any voltage, a primary safety concern in battery systems is that a fault (e.g., caused by a metal tool dropped onto a terminal) might result in a fire or explosion. The best method for reducing this hazard is to ensure that battery systems are guarded, as defined in Section 2.

Rule 64-806
Large banks of storage batteries can deliver significant amounts of short-circuit current. As a result, installers are reminded to ensure that the circuit overcurrent protective devices are selected and coordinated so that the devices will clear a fault without extensively damaging the electrical components of the circuit.

Rule 64-812
Battery plates and terminals are frequently constructed of relatively soft lead and lead alloys encased in plastics that are sealed with asphalt. Large-size, low-stranding stiff copper conductors attached to these components can cause them to become distorted. The use of flexible cables reduces such distortions. Examples of insulated conductors and cables with the appropriate physical and chemical-resistant properties for use with lead-acid batteries are: R90, RW90, RWU90, RPV90, RPVU90, DLO, etc. These insulated conductors and cables address the effects of dc currents and chemicals from lead-acid batteries. This Code does not permit welding and battery cables to be used for this purpose since they have no voltage rating.

Examples of fine strand conductors are Class G, H, M, I, and K

See the Note to Rules 12-406 4) and 64-812.

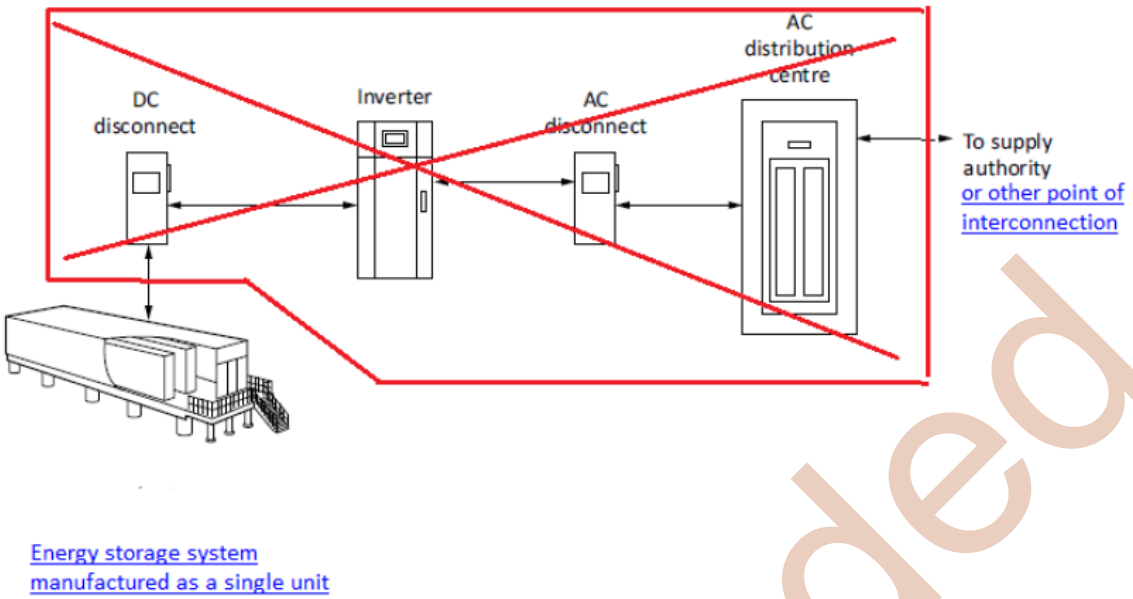
Rule 64-818
Certain battery types, such as lithium-ion, valve-regulated lead-acid, or nickel-cadmium, can experience thermal failure when overcharged.

Rule 64-820
If any portion of a diversion charge control system fails, the batteries may be overcharged, creating a potentially hazardous condition. A second, independent charge control method (usually a series regulator) and robust diversion controller circuits minimize potential problems.

Rule 64-820 3)
An interconnected utility system is not to be considered a reliable diversion load.

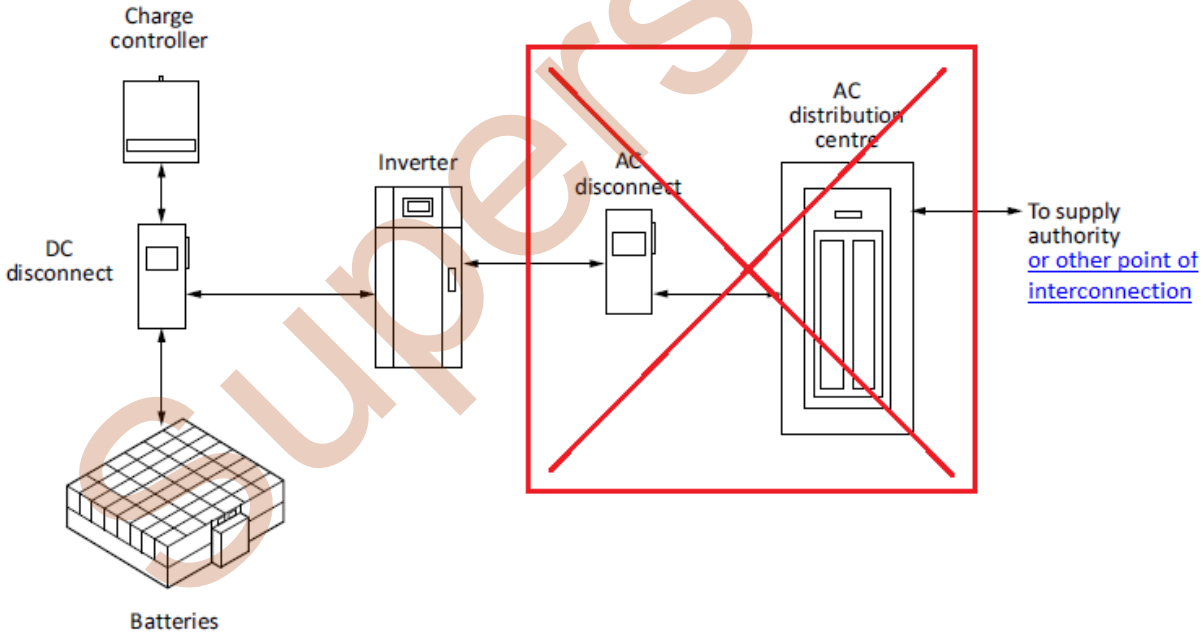
64-900 – see figure B64-9 and B64-10

Figure B64-9
Self-contained energy storage



Note: *Self-contained energy storage systems may include such equipment as inverters and disconnects.*

Figure B64-10
Field-assembled energy storage



Note: *Field assembled energy storage systems may be multi-part assemblies that have been evaluated to UL9540, or an assembly of equipment on site that has not been evaluated to UL9540.*

64-902 3), 64-910 1)

Requirements for marking, installation and maintenance of energy storage systems are found in CAN/UL 9540.

Rule 64-914
Disconnecting means for self-contained energy storage systems may be provided as part of the energy storage systems, or may be required to be installed in accordance with the manufacturer's installation instructions.

Rule 64-916 2)
An example of structures and enclosures housing energy storage equipment includes, but is not limited to, shipping containers, prefabricated buildings, and control panel enclosures.

Rule 64-916 3)
Energy storage systems are bi-directional, and fault current can be available from more than one source. Energy storage system circuits connected in parallel can all contribute to a fault; therefore, bonding conductors should be sized according to the largest overcurrent device in the circuit.

The intent of this rule is to acknowledge that the manufacturer's installation instructions may provide minimum working space requirements in or about equipment forming part of an energy storage system that are different than those required by other rules of this Code.

Rule 64-922 4)
UL 9540 requires charge controllers to be part of the energy storage systems.

Rule 64-924 2)
The intent of this rule is to acknowledge that the manufacturer's installation instructions may provide minimum working space requirements in or about equipment forming part of an energy storage system that are different than those required by other rules of this Code.

Rule 64-1002 3)
See the Note to Rule 2-328.

Rules 2-328, 64-1002 3)
The clearance distances specified in CSA B149.1 between a source of ignition and a combustible gas relief discharge device or vent are as follows:
a) 1 m for natural gas; and
b) 3 m for propane gas.

Rule 64-1100 1)
The acceptability of the fire resistance rating of a dedicated room constructed for the purposes of this rule should be verified by a qualified individual in accordance with the requirements of the authority having jurisdiction prior to installation.

Additional information regarding the Standard Methods of Fire Endurance Tests of Building Construction And Materials is found in CAN/ULC-S101. This standard covers fire endurance tests applicable to walls, partitions, floors, roofs, ceilings, columns, beams, and girders, as well as to some components of these building sub-assemblies.

Alternative locations may be considered, subject to acceptance from the local building, fire, or other appropriate authority having jurisdiction.

Rule 64-1100 8)
The test methodology in the UL9540A standard determines the capability of a battery technology to undergo thermal runaway.

Thermal runaway is defined as “The incident when an electrochemical cell increases its temperature through self-heating in an uncontrollable fashion. The thermal runaway progresses when the cell’s generation of heat is at a higher rate than the heat it can dissipate. This may lead to fire, explosion and gas evolution”.

As part of the energy storage system certification process to UL9540, the testing data generated by UL9540Amay be used to determine acceptable installation practices such as but not limited to location of the energy storage system, aggregate capacity limitations, ventilation, and spacing requirements from other energy storage systems.

The intent of this rule is to recognize where such systems have undergone this testing that the requirements of Subrules 1) through 7) may not be required.

UL 9540 requires energy storage systems intended for installation in the habitable or living space of dwelling units to meet the cell level performance criteria of UL9540A

Application

This variance applies to ESS installed at dwelling units or residential occupancies.

Variance

This variance provides approximately equivalent or greater safety performance required with respect to persons and property as that provided for by the *Safety Codes Act* for ESS’s being installed at dwelling units or residential occupancies provided the following conditions are met.

This variance replaces rules in C22.1:21 – Canadian Electrical Code, Part I 64-000 and 64-800 –64-820 series of rules and 64-900 – 64-928 series of rules, unless specified otherwise, as well as some definitions in 64-002 of the C22.1:21 – Canadian Electrical Code, Part I.

The installation of an ESS, room construction, and smoke alarm location and interconnection must be conducted under both a building and electrical permit.

General requirements

Except as specifically varied in this variance, all sections in the C22.1:21 – Canadian Electrical Code, Part I apply to electrical installations regulated by this variance.

Conditions

The directions specified in this STANDATA intend to harmonize with the proposed C22.1:24 – Canadian Electrical Code, Part I, and ANSI/CAN/UL 9540 standard. Once the CE 2024 Code 26th edition is adopted, this variance is no longer applicable as the requirements for ESS’s will be in the C22.1:24 – Canadian Electrical Code, Part I.

This VARIANCE is applicable throughout the Province of Alberta.