

2018 CANADIAN ELECTRICAL CODE

SUBJECT: Section 64 – Renewable energy systems

Rules 64-210 5), 64-216, and 2-200

Purpose:

Industry has requested clarification on solar photovoltaic (PV) dc arc fault protection and how this relates to rodent protection requirements.

Code references:

64-210 Wiring method

- 5) Where the dc arc-fault protection referred to in Rule 64-216 is not located at the module, photovoltaic source circuit conductors and cables installed on or above a building, and installed in accordance with Subrules 1), 2), and 3) shall be provided with mechanical protection, in the form of an enclosed raceway or other acceptable material to protect against damage from rodents.

64-216 Photovoltaic dc arc-fault circuit protection

- 1) Photovoltaic systems with dc source circuits or output circuits, or both, and operating at a maximum system voltage of 80 V or greater, shall be protected by
 - a) a dc arc-fault circuit interrupter; or
 - b) other system equipment approved to provide equivalent protection.
- 2) The arc-fault protection system required in Subrule 1) shall
 - a) detect and interrupt arcing faults resulting from a failure in the intended continuity of a conductor, connection, photovoltaic module, or other system component in the dc photovoltaic source and output circuits;
 - b) not have the capability of being automatically restarted;
 - c) have annunciation, without an automatic reset, that provides a visual indication that the circuit interrupter has operated; and
 - d) disable or disconnect
 - i) inverters or charge controllers connected to the faulted circuit when the fault is detected; or
 - ii) the photovoltaic dc source circuits or dc output circuits either within the combiner, at the module junction box, or at the module cable connectors.

Issue of this STANDATA is authorized by
the Provincial Electrical Administrator

[Original Signed]

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Protection of persons and property

2-200 General

Electrical equipment shall be installed and guarded so that adequate provision is made for the safety of persons and property and for the protection of the electrical equipment from mechanical or other damage to which it is liable to be exposed.

Discussion:

Solar PV system dc arc-fault protection is designed to detect and mitigate the effects of arcing faults that can pose a risk of fire ignition under certain conditions if the arcing persists. This may be the result of a failure of (or damage to) a conductor, connection, PV module or other system component.

The dc arc-fault protection required under Rule 64-216 provides series arc fault protection. This position is supported by the rule's requirement to detect and interrupt arcing faults resulting from a "failure of the intended continuity of a conductor".

Solar PV inverters sold in Canada are manufactured under a number of standards. Standard CSA C22.2 No. 292 dc arc fault protection for photovoltaic applications has recently been published. Prior to its development, manufacturers followed CSA Technical Information Letter T.I.L. M-07 and the UL1699B standard for photovoltaic dc arc-fault circuit protection. These standards describe testing for both Type 1 series arc-fault protection and Type 2 parallel arc-fault protection.

However, only series faults are required to be detected and protected against by current electrical codes. For this reason, today's Type 1 PV inverters are only certified to detect and interrupt series arc-faults. When the inverter senses a series arc fault within the specified fault value ($\geq 300W$), the inverter shuts down and stops current flow in the entire circuit feeding into that inverter, effectively quenching the arc. This arc fault protection is provided for the entire run of dc conductors from the inverter to the module, inside the module and the connections between modules. When this occurs, the inverter provides a fault message and must be reset manually. Each string in the PV system feeding that inverter must be inspected for faults as per the manufacturers' installation manual.

A certified dc arc fault protective device can also be embodied in a number of ways such as in a combiner box. Module integrated products are in development stages, but are not yet readily available due to a number of technical challenges.

Interpretation:

Subrule 64-210 5)

This Subrule indicates that where the dc arc-fault protection referred to in Rule 64-216 is not located at the module, PV source circuit conductors and cables installed on or above a building require mechanical protection against damage from rodents. Detection and interruption of arc-faults provided by shutdown of an approved Type 1 inverter (or other certified component) referenced in Rule 64-216 is required to quench a series arc-fault. It will accomplish this throughout all of the PV source circuits and PV output circuits connected to that inverter. Because of this protection provided by the inverter (or other certified component), up to and including at the module, there is no requirement for additional rodent protection **above that which would be normally required by Rule 2-200 to protect equipment and cables from damage from environmental hazards which may be present (such as the presence of rodents and wildlife)**, when such equipment that is compliant with Rule 64-216 is installed.

Rule 2-200

Even when arc-fault protection has been provided under the terms of Rule 64-216, **Rule 2-200 requires that electrical equipment be guarded from mechanical or other damage to which it is liable to be exposed.** For solar PV systems, the owner and designer are responsible to identify the likelihood of damage from any means (including rodents) on the specific site of installation. Those specific individual site conditions will dictate the requirement for installation of protection.

For example, a solar array installed on a roof of a house surrounded by mature trees would be a strong candidate for rodent protection compared to an installation on the roof of an industrial building of non-combustible construction.

Caution must be exercised in the application of rodent protection in certain conditions. In flat roof ballasted systems, there is a potential risk of increased wind loading. Racking systems have specific wind tunnel testing to generate wind coefficients but may not include additional mesh/fencing that could create wind drag and change the wind behavior and dynamics of the original design. This could potentially void the engineered racking design. There is also a high likelihood that energy production would be reduced and temperatures increased due to restricted air movement under the array during warmer weather.

For projects with professional involvement, this responsibility to identify the risks and the protection system should fall on the designer and should be fully acknowledged by the owner. It is strongly recommended that the installer consult the local Authority Having Jurisdiction well in advance to discuss the need for, and the type(s) of, additional protection required. No matter what type of equipment is installed, the owner should be made aware that regular inspections of the system are essential.