Bulletin 64-5-5
Installation of solar photovoltaic systems
Rules *14-402*, *64-058*, 64-060, 64-200, 64-214, 64-222, 84-020, 84-024 and 84-030

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1) Introduction

The intent of this bulletin is to clarify some of the solar photovoltaic installation rules.

In combination with this Bulletin, the following documents provide additional information on the installation of solar photovoltaic systems:

- Bulletin 6-7-* Hot splitters and tapping off existing services
- Bulletin 64-2-* Grounding and bonding of solar photovoltaic systems
- Bulletin 64-1-* Utility-interactive inverters
- Bulletin 84-1-* Interconnection of electric power production sources

2) Disconnecting means

a) Disconnecting means for solar photovoltaic source circuits

Question 1
Does Rule 64-060 2) require disconnecting means for each photovoltaic source circuit (panel or modules connected in series)?

Answer 1
No. However, Rule 64-222 requires a disconnect for combiners and recombiners.

According to Appendix B Note for Rule 64-060, an opaque covering is an acceptable means of disabling the array. Servicing the equipment on the photovoltaic side of disconnecting means, such as overcurrent devices or modules, may require disabling all or portions of the array, since PV modules or panels are always energized when exposed to any light source.

b) Disconnecting means for overcurrent protection devices

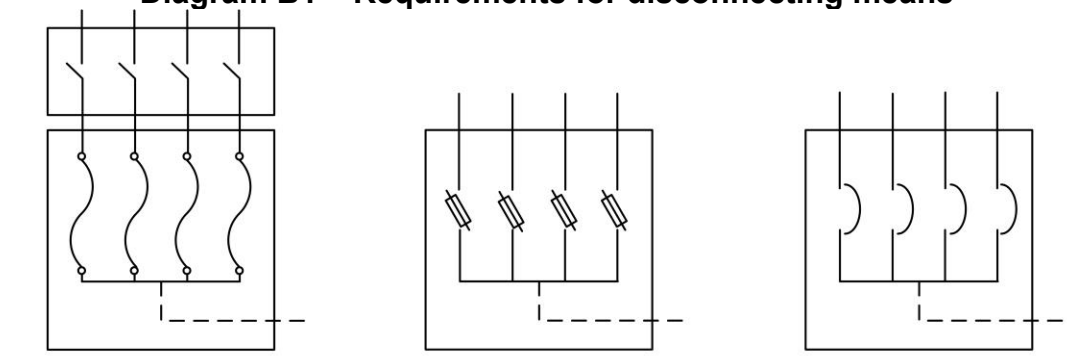
Question 2
Does the Code require disconnecting means for overcurrent devices that may be required by Rule 64-214?

Answer 2
Based on Section 14 and depending on the type of overcurrent protection used, the disconnecting means may or may not be required. It should also be noted that disconnecting means may not be rated as load break devices and should not be operated without first disabling the current source. See Diagram B1:

- Fuses (in non finger safe fuse holders): **Disconnecting means is required**
- Circuit breakers: **Disconnecting means is not required**
- Finger-safe fuse holders & fuses OR Supplementary protectors: **Disconnecting means is not required***

(*) Note:
Not rated to be opened under load.

Diagram B1 – Requirements for disconnecting means



Combiner box with fuses (in non finger-safe fuse holders) Requires disconnection means for overcurrent protection provided for PV source circuits.

Combiner box with finger-safe fuse holders & fuses or supplementary protectors does not require* disconnection means for overcurrent protection provided for PV source circuits.

Combiner box with circuit breakers does not require disconnection means for overcurrent protection provided for PV source circuits.

(*) Not rated to be opened under load.

Question 3
Where disconnecting means is required for fuse holders and fuses (not designed to be finger safe), and is not integral with the combiner box in which the fuses are located, what is meant by “adjacent to” for these types of installations?

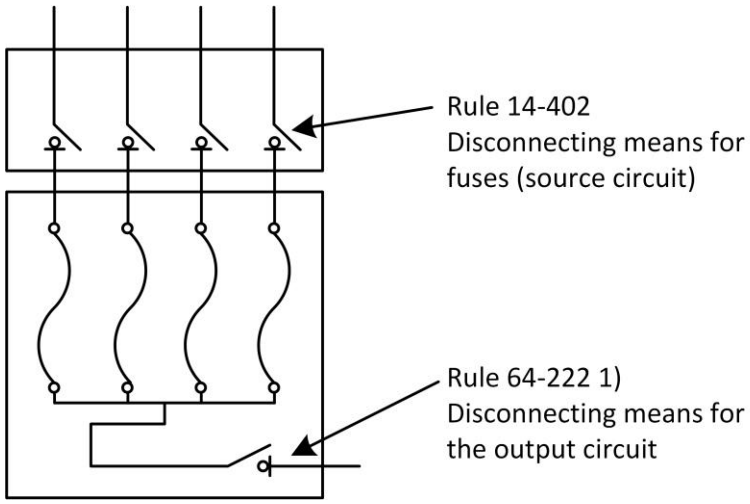
Answer 3
If the disconnecting means is not integral with the fuses, then it shall be installed within sight **and** within 9 m from the fuse holder.

A warning sign is required to indicate that all switches must be opened to de-energize from all sources before replacing fuses.

Question 4
When fuses are used as PV source circuit overcurrent protection, does a disconnecting switch for the output circuit satisfy the requirements for disconnecting means for fuses?

Answer 4
No, Rule 14-402 requires circuits protected by fuses to be equipped with disconnecting means to safely replace fuses.

Diagram B2 – Disconnecting means for fuses used for PV source circuit overcurrent protection



c) Disconnecting means for combiner boxes

As per Rule 64-222 1), a disconnecting means *for the combiner box* is required for the *PV output circuit* and shall be:

- rated to interrupt the load;
- be integral with the combiner box; or
- installed within 2 m of the PV combiner.

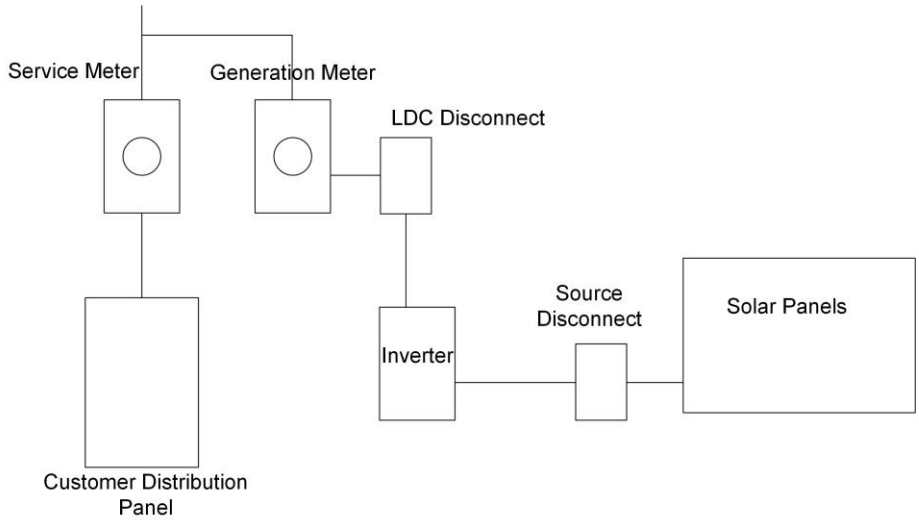
Notwithstanding Rule 64-222 1) a) ii) and 2) a) i), and until further notice, If the combiner or recombiner box is equipped with fuses, a disconnecting means is not required to be interlocked with the door.

3) Single-line diagram and labels

a) Single-line diagram of the interconnected renewable system

Question 5
Does Diagram B3 meet the requirements of Rule 84-030 2) for the single-line diagram of the interconnected system that is located at the supply authority disconnect switch?

Diagram B3 – Typical single-line diagram of the interconnected system with parallel meter connection



Answer 5
Yes, this meets the minimum single-line diagram requirements of Rule 84-030 2).

Note
The system ratings required by Rule 64-200 are not required to be displayed at the supply authority disconnect or on the single-line diagram. The label required by Rule 64-200 shall be posted at the generator (Source) disconnecting means.

b) Labels

Question 6
What Codes or Standards provide requirements for labels, e.g. “DG SOURCE DISCONNECT”, “UTILITY INTERCONNECTED”, “DG SYSTEM DISCONNECT – WARNING – TWO POWER SOURCES”?
Does the code require specific wording?

Answer 6
Rules 2-100, 64-060 and 84-024 require the labels. The Rules do not specify the specific wording.

Markings found in ESA SPEC-004 Electrical guidelines for inverter-based micro-generating facility, which was informed by CSA C22.2 No. 257 (withdrawn) Interconnecting inverter-based micro-distributed resources to distribution systems, may be used as guidance:

- CSA C22.2 No. 257 defined "Distributed generation (DG)" as an electric generation facility connected to a distribution system through the point of common coupling. In Annex B of the standard (that is informative), it shows similar labels as in ESA SPEC-004, i.e. "**DG - source disconnect means**".

*For interactive inverters, **CSA C22.2 No. 107.1 Power conversion** equipment specifies the required product markings based on the inverter's compliance with interconnection standards.*
Inverters (Power Conversion Equipment) evaluated to CSA C22.3 No. 9
Interconnection of distributed energy resources and electricity supply systems shall be marked with one of the following, as applicable:

> ***"Grid Support Interactive Inverter – CSA C22.3 No. 9 - Basic"*** *or*
> ***"Grid Support Interactive Inverter – CSA C22.3 No. 9 - Supplemental"***

Inverters (Power Conversion Equipment) not evaluated to CSA C22.3 No. 9 *shall be marked:*

> ***"Not evaluated to CSA C22.3 No. 9. Refer to manual. Provided with anti-islanding protection"***

Question 7
What is considered acceptable for exterior, weatherproof labels required by the Code? Does the code specify letter size?

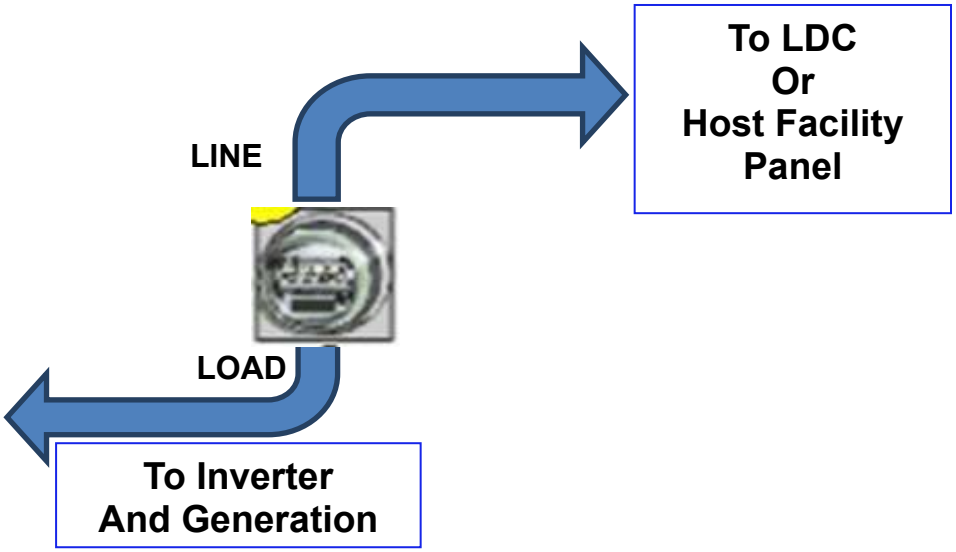
Answer 7
The Code does not provide specific requirements; the labels need to be able to withstand the elements, be permanent and legible, for example: lamacoid, engraved metal plate, or equivalent. Additionally, the label has to satisfy the local supply authority requirements.

4) Electricity meters

a) Generator metering connection

Direction
As per Diagram B4, the Line side of the metering cabinet is connected to the utility and the Load side is connected to the customer, to ensure consistency and safety.

Diagram B4 – Generation meter connection

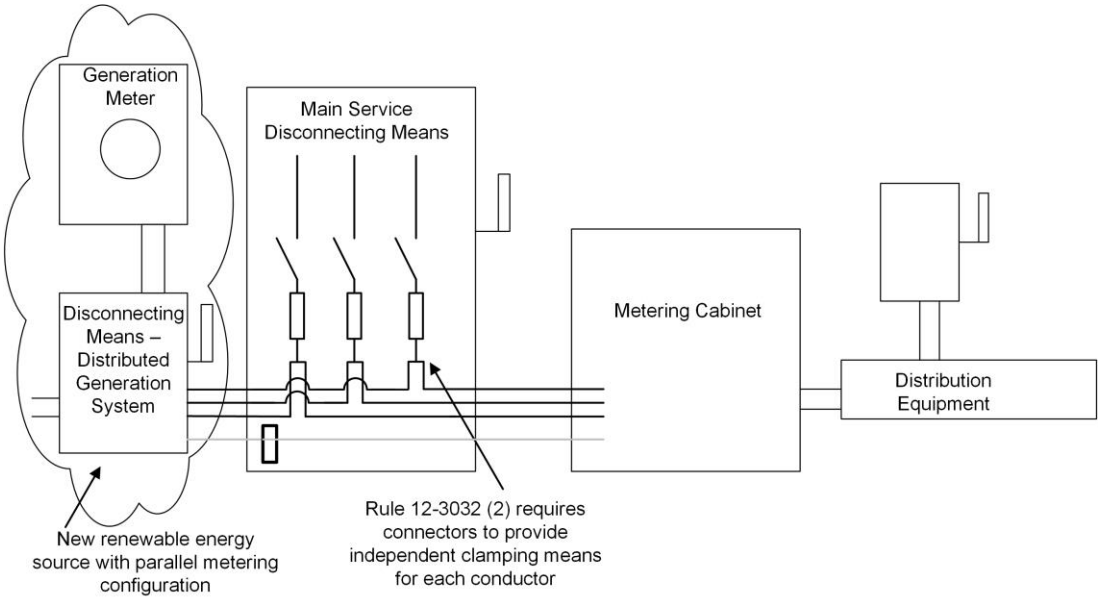


Rationale
When pulling a meter, the standard practice is that the Load side of the metering cabinet will be de-energized and caution is taken around the Line side, as it may be energized.

b) Tapping to the load side of the service box for a parallel metering connection

Question 9
In installations where the existing customer load meter is downstream of the main service disconnect, does the Code permit tapping to the load side lugs of the service disconnect for an embedded electric power production source for the application of Section 64, as per Diagram B5?

Diagram B5 – Tapping to the to the load side lugs of the service disconnect



Answer 9

Yes. According to Bulletin 6-7-*, a maximum of one tap is permitted per service box. Therefore, the ***generation*** meter in a parallel configuration is allowed to be connected to the load side lugs of the service disconnect and be terminated in accordance with Bulletin 6-7-*.

5) AC modules and micro-inverters

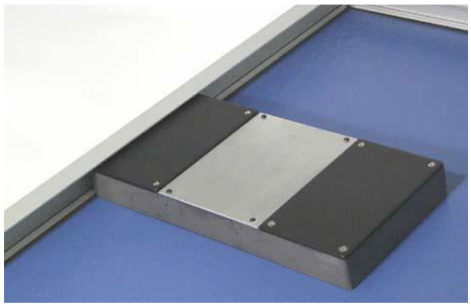
Rule 64-002 defines an ac module as “a complete, environmentally protected assembly of interconnected solar cells, inverter, and other components designed to generate ac power from sunlight”.

AC modules are designed to generate ac power when exposed to sunlight and do not have accessible, field installed dc wiring (as shown in Photo B1).

a) Disconnecting means

For ac modules where the inverter is an integral part of the generator (as shown in Photo B1), and the combined unit is approved, there is no requirement for a disconnecting means for the integral inverter. If, however, any other electric power production source is interconnected with an ac module, the disconnecting means, in accordance with Rule 84-020, is required for all production sources.

Photo B1 – AC module where the inverter is an integral part of the generator



For micro-inverters, inverters plugged into the photovoltaic panels (as shown in Photo B2), no additional disconnect switch is required.

Photo B2 – Micro-inverter



b) Overcurrent protection

The output circuits of ac modules shall have overcurrent protection according to Rule 64-058 requirements.

c) Marking of photovoltaic circuit

Question 10
Does the OESC require marking of a PV system with ac modules, when interconnecting to the supply authority?

Answer 10
Yes. Although requirements of Rule 64-200 for marking of the photovoltaic output circuit at the generator disconnecting means are not applicable to ac modules, *Rule 64-074 requires that all interactive system(s) points of interconnection with other sources shall be marked with the rated ac operating voltage and current.* As per Rule 2-100, PV installations utilizing ac modules connected to the supply authority shall be marked to identify the PV system rating and suitability for the particular installation.

Question 11
What is the required marking for a PV system with ac modules?

Answer 11
According to Rule 2-100, *Rule 64-074 and the intent o*f Rule 64-200, the required marking for PV installations utilizing ac modules connected to the supply authority are:

- rated ac output current
- nominal operating ac voltage

Question 12
Where is the marking for a PV system with ac modules required to be located?

Answer 12
The required marking by Rules 2-100*, 64-074* and 64-200 for PV installations utilizing ac modules connected to the supply authority shall be located at the supply authority disconnect; and be included in the single-line diagram required by Rule 84-030 2).
Note: The required warning notice for PV installations utilizing ac modules connected to the supply authority shall be located at the supply authority disconnect and the meter location as required by Rule 84-030 1) .A single-line diagram shall be installed at the supply authority's disconnecting means as required by Rule 84-030 2).

6) Replacement of PV inverters from central to string type

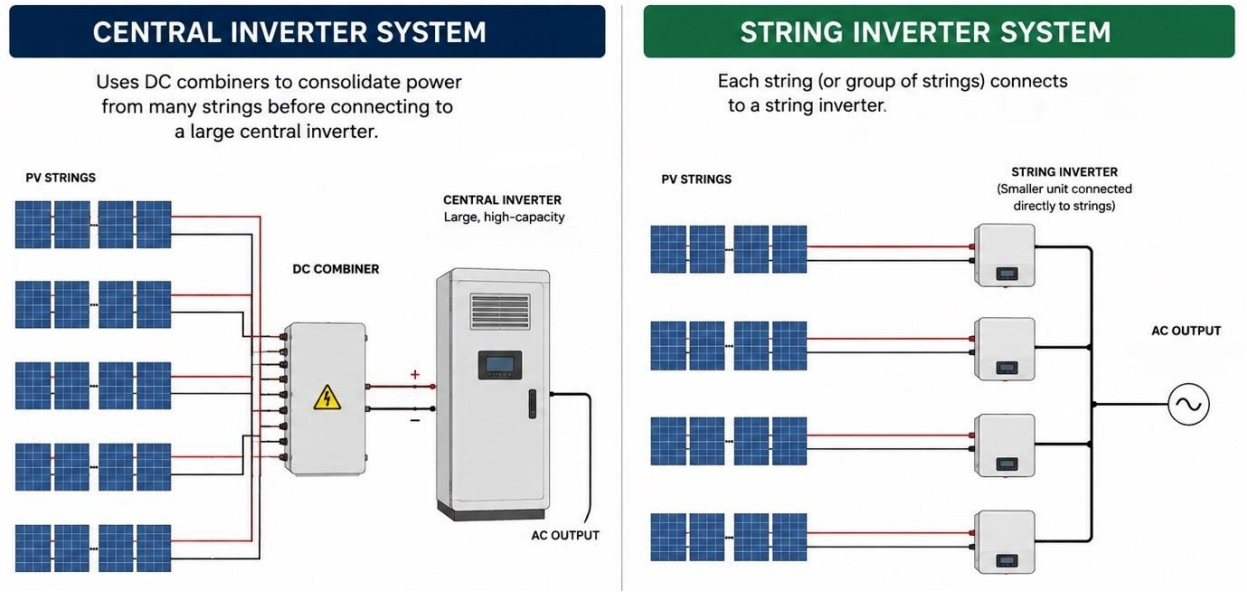
Background

As photovoltaic (PV) installations age, many central inverters are becoming obsolete, with no direct or comparable replacements available. This has led designers to inquire whether replacing a central inverter with a string inverter system requires updating the entire installation to meet current electrical code requirements.

Comparison of Inverter Systems

- ***Central Inverters:*** *These are large, high-capacity units that typically take only one or two DC inputs. The system architecture for central inverters is generally built using* ***DC combiners and recombiners*** *to consolidate the power before it reaches the inverter.*
- ***String Inverters:*** *These are smaller units designed to connect directly to multiple strings of solar modules. These systems typically do* ***not use external DC combiners****, as the strings are combined within the inverter.*

Diagram B6 – Central vs string inverter



Question 13 : *Is a system being retrofitted from* ***central to string inverters*** *required to be brought up to current code requirements throughout if DC wiring is replaced (to remove the combiner boxes) even if the inverter(s) have a total equivalent output?*

Answer 13: Yes.

Retrofitting from central to string inverters shall be considered as a ***new installation****, requiring the entire system to be brought up to current code requirements throughout.*

Transition from a central inverter architecture to a string inverter architecture may involve significant changes to the system's design and DC wiring, such as replacing DC wiring and removing legacy combiner boxes, requiring the entire system to be brought up to current code requirements throughout.

Note: It is the responsibility of the notification holder to ensure all requirements per current code are met

7) Maintenance and repair of solar photovoltaic (PV) systems

Question 14:

Is it required to update an existing photovoltaic system to current code requirements when performing maintenance and repairs such as, replacing modules with the same characteristics (wiring to remain), replacing modules with different ratings (same wiring and inverter to remain), or replacing an inverter with one that is ***similar in electrical ratings and characteristics****?*

Answer 14: No.

(Note: If the entire installation is replaced, such as due to a fire, or reconfigured as described in Question and Answer 13, then current OESC requirements apply).

Question 15:

Is a notification required for removal and re-installation of an existing PV system for example during repair of roof structure?

Answer 15:

Yes*, a notification is required. Refer to Question and Answer 14 for clarification regarding applicable code requirements.*