

# FORM FOR COMMENT FOR 2014 NATIONAL ELECTRICAL CODE®

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Type or print **legibly**. Use a separate copy for each comment. Limit each comment to a **SINGLE** section. All comments **must be received by NFPA by 5 p.m., EDST, Wednesday, October 17, 2012**, to be considered for the 2014 National Electrical Code. Comments received after 5:00 p.m., EDST, Wednesday, October 17, 2012, will be returned to the submitter.

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Please indicate organization represented (if any) PV INDUSTRY FORUM

1. Section/Paragraph 705.12

2. Comment on Proposal No. (from ROP): 4-375a

3. Comment recommends (check one): ☐ new text ☒ revised text ☐ deleted text

4. Comment (include proposed new or revised wording, or identification of wording to be deleted): [Note: Proposed text should be in legislative format; i.e., use underscore to denote wording to be inserted (inserted wording) and strike-through to denote wording to be deleted (~~deleted wording~~).

Modify the ROP 4-375 language as follows:

**(D) Utility-Interactive Inverters.** The output of a utility interactive inverter shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment on the premises.

Where distribution equipment, including switchgear, switchboards, or panelboards, is fed simultaneously by a primary source(s) of electricity and one or more utility interactive inverters, and where this distribution equipment is capable of supplying multiple branch circuits or feeders or both, the interconnecting provisions for the utility interactive inverter(s) shall comply with (D)(1) through (D)(7).

**(1) Dedicated Overcurrent and Disconnect.** The source interconnection of ~~one or more~~ each inverters installed in one system shall be made at a dedicated circuit breaker or fusible disconnecting means.

**(2) Bus or Conductor Ampere Rating.** For all bus and feeder ampacity calculations, 125% of the inverter output circuit current shall be used. ~~In systems w~~ Where inverter output connections are made at feeders, the calculations for load connections (taps), if any, shall use the rating of the existing overcurrent device in the circuit plus 125% of the inverter(s) rated output current as the overcurrent device protecting the conductors in the 240.21(B) calculations.

Where an inverter(s) is connected to an existing feeder, that feeder shall have an ampacity no less than the sum of the primary supply overcurrent device plus 125% of the inverter(s) rated output current.

Exception: Where the inverter(s) connection (s) and primary supply are at opposite ends of the feeder, the feeder shall have an ampacity no less than the larger of the primary supply overcurrent device or 125% of the rated output current of the inverter(s). And the feeder shall be marked at accessible point(s) every 3 meters (10 feet) with the following or equivalent wording:

**WARNING:**  
**MULTIPLE SOURCES OF POWER**  
**DO NOT TAP**

One of the methods in (a)-(d) shall be used to determine the ratings of busbars in panelboards:

(a) The sum of 125% of the inverter(s) output circuit current and the rating of the overcurrent device protecting the busbar shall not exceed the ampacity of the busbar.

Informational Note: This general rule assumes no limitation in the number of the loads or sources applied to a busbar or their locations.

(b) Where two ~~or more~~ sources, one utility and ~~the other an~~ one or more inverters, are located at opposite ends of a busbar that contains loads, the sum of 125% of the inverter(s) output circuit current and the rating of the overcurrent device protecting the busbar

shall not exceed 120% the ampacity of the busbar. The busbar shall be sized at least for the loads connected in accordance with Article 220. A permanent warning label shall be applied to the distribution equipment adjacent to the backfed breaker from the inverter with the following or equivalent wording:

WARNING:  
INVERTER OUTPUT CONNECTION,  
DO NOT RELOCATE THIS OVERCURRENT DEVICE

The warning sign(s) or label (s) shall comply with 110.21(B).

*Exception: Equipment with multiple ampacity busbars or center fed panelboards are not addressed by this provision.*

(c) The sum of the ampere ratings of all overcurrent devices on panelboards, both load and supply devices, excluding the rating of the overcurrent device protecting the busbar, shall not exceed the ampacity of the busbar. The rating of the overcurrent device protecting the busbar shall not exceed the rating of the busbar. Permanent warning labels shall be applied to distribution equipment with the following or equivalent wording:

WARNING:  
THIS EQUIPMENT FED BY MULTIPLE SOURCES.  
TOTAL RATING OF ALL OVERCURRENT DEVICES,  
EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE,  
SHALL NOT EXCEED AMPACITY OF BUSBAR.

The warning sign(s) or label(s) shall comply with 110.21(B).

(d) Connections shall be permitted on multiple ampacity busbars, or center fed panelboards where designed under engineering supervision that include fault studies and busbar load calculations.

**(3) Marking.** Equipment containing overcurrent devices in circuits supplying power to a busbar or conductor supplied from multiple sources shall be marked to indicate the presence of all sources.

**(4) Suitable for Backfeed.** Circuit breakers, if backfed, shall be suitable for such operation.

Informational Note: Fused disconnects, unless otherwise marked, are suitable for backfeeding.

**(5) Fastening.** Listed plug-in-type circuit breakers backfed from utility-interactive inverters that are listed and identified as interactive shall be permitted to omit the additional fastener normally required by 408.36(D) for such applications.

**(6) Inverter Output Connection.** The position of overcurrent devices supplying current to a conductor or busbar with respect to the position of the overcurrent devices connected to the utility source of supply shall be used to determine the calculated ampacity of the conductor or the rating of the panelboard bus bar in accordance with a, b and c.

(a) Where the overcurrent devices from inverter outputs supplying a panelboard are not located at the opposite end of the busbar from the utility input feeder or main overcurrent device location, the panelboard shall be rated not less than the sum of the ampere ratings of all overcurrent devices supplying it.

(b) In systems with panelboards connected in series, the rating of the first overcurrent device directly connected to the output of a utility-interactive inverter(s) shall be used in the calculations for all busbars and conductors where the circuits from the inverter supply sources are connected to the opposite end of the busbar or conductor from the circuit from the utility source of supply.

A permanent warning label shall be applied to the distribution equipment where backfed overcurrent devices may carry currents from the PV inverters with the following or equivalent wording:

WARNING  
INVERTER OUTPUT CONNECTION  
DO NOT RELOCATE THIS OVERCURRENT DEVICE

The warning sign(s) or label(s) shall comply with 110.21(B).

(c) The bus or conductor rating shall be sized not less than the loads connected in accordance with Article 220.

**(7) Wire Harness and Exposed Cable Arc Fault Protection.**

Utility interactive inverter(s) that have a wire harness or cable output circuit, rated 240V, 30A or less, that is not installed within an enclosed raceway, shall be provided with listed AC AFCI protection.

(D)(1) As written, the text could (and will) be interpreted as allowing inverters to be paralleled on a single disconnect and OCPD and this could result in islanding and possible over loading of conductors under fault conditions. Only listed devices such as microinverters and ac PV modules have this allowance as part of the listing.

12(D)(2) The tap section was revised to clearly (hopefully) indicate that the material applies to load taps on feeders where inverters are on the circuit and does not apply to the inverter connections themselves.

The feeder section was added, because the ampacity of feeders with utility and PV inverter connections is not directly addressed anywhere. Connecting the output of a utility interactive inverter(s) through an OCPD/disconnect to the feeder inside a panel board is quite common in making load side connections. If an inverter is connected to the output of a breaker for a feeder, then that feeder may be subject to the combined output of the breaker and the inverter if loads on the feeder are increased. The first paragraph addresses the general requirement for feeder protection. The exception brings common sense and engineering calculations into the equation, that is; where the supplies are at opposite ends of the feeders, then the maximum current that the feeder can see (at any point) is limited to the larger of the two sources. The warning is needed so that taps are not made and the tap rules corrupted when the second source is not known.

(2)(b). Covering the multiple inverter case. We should not have two conflicting ampacity requirements and the “at least” allows the conductors to be larger than load requirements when the inverters have high currents, but keeps the busbars sized to meet load requirements when there are no inverter currents.

(6) Revised for clarity. The language is pretty bad and has been for several cycles.

(6)(b) Revised to indicate that the only way to use the first OCPD device in the series panel calculations is where the OCPDs supplying each panel board or conductor are at the opposite ends of that panel board or conductor. If not, there is a potential for panel board or conductor overloading.

(6)(c) Added “not less than” to remove the conflicting double requirements on the ampacity calculation.

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10/15/2012