

# FORM FOR PROPOSAL FOR 2014 NATIONAL ELECTRICAL CODE®

## INSTRUCTIONS — PLEASE READ CAREFULLY

Type or print **legibly** in **black ink**. Use a separate copy for each proposal. Limit each proposal to a **SINGLE** section. All proposals **must be received by NFPA by 5 p.m., EST, Friday, November 4, 2011**, to be considered for the 2014 National Electrical Code. Proposals received after 5:00 p.m., EST, Friday, November 4, 2011, will be returned to the submitter. If supplementary material (photographs, diagrams, reports, etc.) is included, you may be required to submit sufficient copies for all members and alternates of the technical committee.

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Please indicate organization represented (if any) PV INDUSTRY FORUM

1. Section/Paragraph 705.12(D)

2. Proposal Recommends (check one):  new text  revised text  deleted text

3. Proposal (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~~).]

Revise 705.12(D) 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 switchboards and 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)(~~6~~ 7).

**(1) Dedicated Overcurrent and Disconnect.** Each source interconnection shall be made at a dedicated circuit breaker or fusible disconnecting means.

Informational Note: The circuit carrying the ac output of a utility interactive inverter is not subject to high fault currents from the inverter. The inverter output current and power are limited to the rated values with no long-term surge capability. These ac output circuits are similar to branch circuits in terms of circuit protection and the overcurrent device should be at the utility source end, and is typically a backfed circuit breaker.

**(2) Bus or Conductor Ampere Rating.** The continuous current output of the inverter(s) shall not exceed the ampere rating of the busbar or conductor to which they are connected. In systems where panelboards are connected in series, the ampere rating of the first overcurrent device connected directly to the inverter(s) shall be used in the calculations for all busbars and conductors. The busbar or conductor shall be sized for the loads connected in accordance with Article 220. One of the methods in (a)-(e) shall be used to determine the ratings of busbars in

panelboards or the ampacity of conductors:

(a) The sum of the ampere ratings of the overcurrent devices supplying power to the busbar or conductor shall not exceed the ampacity of the busbar or conductor.

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 supply sources are located at opposite ends of a conductor that contains no taps, the ampacity of the conductor shall not be less than the ampere rating of the largest overcurrent device supplying power to the conductor. Permanent warning labels shall be applied at conductor access points, and at 2.8m (10 ft) intervals along accessible raceways, with the following or equivalent wording:

WARNING  
THIS CIRCUIT FED BY MULTIPLE SOURCES  
DO NOT TAP CONDUCTOR.

(c) Where two sources, one utility and the other an inverter, are located at opposite ends of a busbar or conductor that contains loads, the sum of the ampere ratings of the overcurrent protection supplying power to the busbar or conductor shall not exceed 120% the ampacity of the busbar or conductor. 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

*Exception: Panelboards with multiple ampacity busworks or center fed panel boards are not addressed by this provision.*

(d) The sum of the ampere ratings of all overcurrent devices on panelboards, both load and supply devices, excluding the main supply overcurrent device, shall not exceed the ampacity of the busbar. The ampere rating of the main supply overcurrent device 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.

(e) Connections shall be permitted on feeders where designed under engineering supervision that includes, but is not limited to, fault studies and conductor damage curves.

*Exception: Where the photovoltaic system has an energy storage device to allow stand-alone operation of loads, 125% of the rated utility-interactive current from the multimode inverter shall be permitted to be used in the calculation of bus rating or conductor ampacity instead of the*

*rating of the overcurrent device between the inverter and the bus or conductor.*

**(3) Ground-Fault Protection.** ~~The interconnection point shall be on the line side of all ground-fault protection equipment.~~ Equipment requiring ground fault protection shall comply with either a or b.

*~~Exception: Connection shall be permitted to be made to the load side of ground fault protection, provided that there is ground fault protection for equipment from all groundfault current sources. Ground fault protection devices used with supplies connected to the load side terminals shall be identified and listed as suitable for backfeeding.~~*

a. The interconnection point shall be on the line side of all ground-fault protection equipment.

b. The interconnection shall be permitted to be made on the load side of ground-fault protection where the following requirements are met: Ground-fault protection is provided for all equipment from all ground-fault current sources; Ground-fault protection devices used with supplies connected to the load-side terminals shall be identified and listed suitable for backfeeding; Engineering assessments shall be made to determine distribution of fault currents between the ground fault devices and the trip settings of each ground fault protection device.

**(4) 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.

**(5) Suitable for Backfeed.** Circuit breakers, if backfed, shall be suitable for such operation. Fused disconnects, unless otherwise marked, are suitable for backfeeding.

FPN: Circuit breakers that are marked “Line” and “Load” have been evaluated only in the direction marked. Circuit breakers without “Line” and “Load” have been evaluated in both directions.

**(6) 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.

**(7) Inverter Output Connection.** ~~Unless the panelboard is rated not less than the sum of the ampere ratings of all overcurrent devices supplying it, a connection in a panelboard shall be positioned at the opposite (load) end from the input feeder location or main circuit location. The bus or conductor rating shall be sized for the loads connected in accordance with Article 220. 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. A permanent warning label shall be applied to the distribution equipment with the following or equivalent wording:~~

**WARNING  
INVERTER OUTPUT CONNECTION  
DO NOT RELOCATE THIS  
OVERCURRENT DEVICE**

**4. Statement of Problem and Substantiation for Proposal:** (Note: State the problem that would be resolved by your recommendation; give the specific reason for your Proposal, including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

**It is critical to understand that electricians regularly tap feeders and other circuits without fully verifying what is connected to the circuits. Both conductors and busbars must be protected when PV systems are connected to these circuits. This integrated proposal maintains the protection established early on in the Code for PV systems and makes safe allowances for additional connections.** 690.64(B)(2)/705.12(D) was edited extensively during code making panel meetings for 2008 and was not changed in 2011. Subparagraph (D)(7) is very difficult to read and understand. New, and safe methods or connecting utility-interactive inverters to conductors and panelboards have been identified and defined. This proposed revision addresses those items and others as noted.

(D) Introduction—No change except in the numbering of the paragraph that was changed from 7 to 6 because (7) has been included in (2).

(D)(1) No change

The Informational Note is added to ensure that the ac output circuit overcurrent protection is positioned at the proper location, not at the inverter end of the circuit, where it has no affect and places the circuit under 705.12(D) sizing restrictions.

(D)(2) Substantial changes to allow additional safe and cost effective methods of connecting the output of utility-interactive inverters to a panelboard bus bar or a conductor.

The second sentence is extracted from 690.64(B)(2) in the *2008 NEC* that was omitted in error during the transition to 705.

(a) This general rule as explained by the FPN ensures that any conductor or bus bar with multiple sources and multiple loads will be protected. The position on the busbar or conductor of either the supply or the load overcurrent devices does not affect the protection under this general requirement.

(b) With these restrictions on the location of sources at each end, it is not possible to overload a conductor through the connection of any load in any position.

(c) This is a revision of 705.12(D)(7) for clarity. It belongs under (D), as it is a method of determining bus rating and protection. The warning is self-explanatory.

The exception is required because multiple ampacity busworks center tapped bus bars cannot be protected by this method.

(d) This new allowance protects the busbar or conductor by limiting the sum of the ratings of all (source and load) overcurrent devices, except the overcurrent device on the main (largest) source. For example: With a 100 amp bus, the method would allow 100 amps of supply breakers and no load breakers, 100 amps of load breakers and no supply breakers, or any combination of the two adding to 100 amps or less. The rating of the main breaker need not be counted in protecting the busbar except that its rating must also not exceed the bus bar rating.

(e). This new allowance lets engineering evaluations be made by qualified people in making taps

where multiple sources of power are involved.

Exception: Combinations of loads in a panel board or load center and multimode inverters frequently do not consider the fact that the multimode inverters can act as loads when operating in the battery-charging mode. This last line draws attention to that frequently overlooked fact.

(3) The section is revised with the exception being deleted and replaced by two more restrictive requirements.

When a PV inverter feeds a load side connection, ground faults on load circuits that were previously protected by a main breaker ground fault protective device (GFP) and sourced by the utility may now be sourced by both the utility and the inverter. Stiff grids on large service entrances may hold line voltages up preventing the inverter's anti-islanding systems from shutting the inverter down when a ground fault occurs. Ground fault currents will be divided between the utility and the inverter and inverter supplied fault currents may prevent the main breaker GFP from activating at the desired set point. Engineering assessments are needed to determine circuit impedances for the division of fault currents between multiple sources and the appropriate settings for multiple ground fault protective devices.

Manufacturers maintain most new main breaker GFPs are OK for backfeeding, but cannot say about older units and for some the manufacturer may be out of business.

The listing requirement has been deleted because accessories like GFP attachments to circuit breakers are not tested and listed for backfeeding. The manufacturer identifies which units are suitable for backfeeding.

(4) and (5) no change.

(6) Needed for clarity because many AHJs bring up this as an issue.

(7) is deleted, the requirements revised for clarity, and placed in (D) (2).

#### 5. Copyright Assignment

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(b)  Some or all of the text or other material proposed in this Proposal was not authored by me. Its source is as follows: (please identify which material and provide complete information on its source)

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Signature (Required)

*John L. Wilco, Jr.*

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