First Revision No. 8644-NFPA 70-2018 [Detail]

REVISE TITLE OF SECTION 690.15 FROM:

Disconnection of Photovoltaic Equipment.

TO

Disconnecting Means for Isolating Photovoltaic Equipment.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 07:51:53 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The title has been revised clearly show that this section addresses isolation of equipment from energized conductors.

Response Message:

Public Input No. 3007-NFPA 70-2017 [Section No. 690.15]

Public Input No. 3949-NFPA 70-2017 [Section No. 690.15]

First Revision No. 8704-NFPA 70-2018 [Detail]

Revise title of 690.31 from:

Methods Permitted.

to

Wiring Methods.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 13:27:46 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The word “permitted” is deleted as it is an unnecessary word, as the Code already addresses what is and is not permitted.

Response Message:

Public Input No. 3015-NFPA 70-2017 [Section No. 690.31]

First Revision No. 8741-NFPA 70-2018 [Detail]

690.2 Definitions.

The definitions in this section shall apply only within this article.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 16:32:53 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This statement makes it clear that any definitions for similar terms used in the NEC must either be here or in Article 100.

Response Message:

Public Input No. 1967-NFPA 70-2017 [Section No. 690.2]

First Revision No. 8743-NFPA 70-2018 [Detail]

705.2 Definitions.

The definitions in this section shall apply within this article and throughout the *Code*.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 16:41:21 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Any definitions in Article 705 also apply if the term is used elsewhere in the NEC.
Response Message:

Public Input No. 2235-NFPA 70-2017 [Section No. 705.2]

Editorial Comment

Click here

First Revision No. 8940-NFPA 70-2018 [Detail]

Former sections 690.31(D), (E) and (F) are being moved up into 690.31(C) as items (3), (4), etc. with the inclusion of a new (5).
(3) Multiconductor Cable.

~~Jacketed~~Distributed generation (DG) cable and other jacketed multiconductor cable assemblies ~~listed and identified for the application~~used in accordance with their listings shall be permitted in outdoor locations. The cable shall be secured at intervals not exceeding 1.8 m (6 ft).

(4) Flexible Cords and Cables Connected to Tracking PV Arrays.

Flexible cords and flexible cables, where connected to moving parts of tracking PV arrays, shall comply with Article 400 and shall be of a type identified as a hard service cord or portable power cable; they shall be suitable for extra-hard usage, listed for outdoor use, water resistant, and sunlight resistant. Allowable ampacities shall be in accordance with 400.5. Stranded copper PV wire shall be permitted to be connected to moving parts of tracking PV arrays in accordance with the minimum number of strands specified in Table 690.31(C)(4).

Table 690.31(C)(4) Minimum PV Wire Strands

PV Wire AWG	Minimum Strands
18	17
16–10	19
8–4	49
2	130
1 AWG–1000 MCM	259

(5) **Flexible, Fine-Stranded Cables.**

Flexible, fine-stranded cables shall be terminated only with terminals, lugs, devices, or connectors in accordance with 110.14.

(6) Small-Conductor Cables.

Single-conductor cables listed for outdoor use that are sunlight resistant and moisture resistant in sizes 16 AWG and 18 AWG shall be permitted for module interconnections where such cables meet the ampacity requirements of 400.5. Section 310.14 shall be used to determine the cable ampacity adjustment and correction factors.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 24 07:46:09 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Item (3) adds a new designation to multiconductor cable. UL3003 is a new outline of investigation for Distributed Generation (DG) Cables which is being used to evaluate and certify a cable type specifically

for DG applications. DG cable is closely related to TC-ER, but it is better suited for the renewable energy and other DG applications allowing for different variations in conductor combinations within a single jacket. Item 5 is moved from former 690.31(H).

Response Message:

Public Input No. 3804-NFPA 70-2017 [Section No. 690.31(D)]

Public Input No. 3942-NFPA 70-2017 [Section No. 690.31(D)]

Editorial Comment

Click here

First Revision No. 8949-NFPA 70-2018 [Detail]

Modify the title of Article 691 from

Article 691 Large-Scale Photovoltaic (PV) Electric Power Production Facility

to

Article 691 Large-Scale Photovoltaic (PV) Electric Supply Stations

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 24 09:07:50 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The term “power production facility” is only used in the title and scope of Article 691, and is inconsistent with the term “supply station” which is used 12 times throughout Article 691

Response Message:

First Revision No. 8992-NFPA 70-2018 [Detail]

Under the title of **692.2** Definitions.

Add the sentence:

The following definition(s) shall apply only within this article.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 25 15:30:04 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The statement “The following definition(s) shall apply only within this article” was added per the Correlating Committee request.

Response Message:

Public Input No. 2244-NFPA 70-2017 [Section No. 692.2]

First Revision No. 9002-NFPA 70-2018 [Detail]

[691.2] The definitions in this section shall apply only within this article.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 29 09:28:43 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The added statement addresses potential issues in the NEC with respect to how definitions in both Article 100 and Article 691 apply

Response Message:

Public Input No. 1968-NFPA 70-2017 [Section No. 691.2]

First Revision No. 8415-NFPA 70-2018 [Section No. 690.46]

~~**690.46** Array Equipment Grounding Conductors.~~

~~For PV modules, equipment grounding conductors smaller than 6 AWG shall comply with 250.120(C)~~ .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 16:06:23 EST 2018

Committee Statement and Meeting Notes

Committee Statement: These requirements have been incorporated into a new 690.43(E) subsection.
Response Message:

Public Input No. 1850-NFPA 70-2017 [Section No. 690.46]

Public Input No. 3028-NFPA 70-2017 [Section No. 690.46]

First Revision No. 8493-NFPA 70-2018 [Section No. 694.22(C)(1)]

(1) Location.

The wind electric system disconnecting means shall be installed at a readily accessible location either on or adjacent to the turbine tower, on the outside of a building or structure, or inside at the point of entrance of the wind system conductors.

Exception: Installations that comply with 694.30(C) shall be permitted to have the disconnecting means located remotely from the point of entry of the wind system conductors.

A wind turbine disconnecting means shall not be required to be located at the nacelle or tower.

The disconnecting means shall not be installed in bathrooms.

For one-family and two-family dwellings, a disconnecting means or manual shutdown button or switch shall be located at a readily accessible location outside the building.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 08:54:20 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision correlates various sections of the NEC and consistently requires this important on-site source disconnecting switch. This switch is to be located outside a one or two family dwelling regardless of whether the utility service equipment is located indoors or outdoors. This should provide ready access by first responders to secure these sources prior to entering the dwelling since their outdoor location will be clearly marked on the required placards.

Response Message:

Public Input No. 3780-NFPA 70-2017 [Section No. 694.22(C)(1)]

Editorial Comment

Click here

First Revision No. 8703-NFPA 70-2018 [Part IV.]

Part IV. Wiring Methods and Materials

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 13:25:55 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The words “AND MATERIALS” is added to the title of Part IV, to better align with other uses in the Code such as the title of Chapter 3.

Response Message:

Public Input No. 3014-NFPA 70-2017 [Part IV.]

Editorial Comment

Click here

First Revision No. 8553-NFPA 70-2018 [Definition: Photovoltaic (PV) System.]

Photovoltaic (PV) System.

The total components ~~and subsystem~~ , circuits, and equipment up to and including the PV system disconnecting means that, in combination, convert solar energy into electric energy ~~for connection to a utilization load~~ . (CMP-4)

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 13:05:54 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Language about utilization loads has been removed since a PV system may have no direct connection to loads. The purpose of all electricity is to eventually operate utilization loads so the key should be defining what it is, not what electricity is for.

Response Message:

Public Input No. 354-NFPA 70-2017 [New Section after 690.2]

Public Input No. 4179-NFPA 70-2017 [Definition: Photovoltaic (PV) System.]

First Revision No. 8728-NFPA 70-2018 [Definition: Stand-Alone System.]

Stand-Alone System.

A system that ~~supplies power independently~~ is capable of supplying power independent of an ~~electrical~~ electric power production and distribution network.(CMP-4)

Informational Note: Though stand-alone systems are capable of operating independent of a utility supply they may include a connection to a utility supply for use when not operating in stand-alone mode.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 15:49:06 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This definition was revised to indicate that a stand-alone system is not limited by the presence of a utility system.
Response Message:

Public Input No. 4218-NFPA 70-2017 [Definition: Stand-Alone System.]

Public Input No. 4322-NFPA 70-2017 [Definition: Stand-Alone System.]

Public Input No. 4223-NFPA 70-2017 [Definition: Stand-Alone System.]

Editorial Comment

Click here

First Revision No. 8568-NFPA 70-2018 [Section No. 690.1]

690.1 Scope.

This article applies to solar PV systems, other than those covered by Article 691, including the array circuit(s), inverter(s), and controller(s) for such systems. ~~*[See Figure 690.1(a) and Figure 690.1(b) .]*~~ The systems covered by this article ~~may be~~ include those interactive with other ~~electrical~~ electric power production sources or stand-alone, or both~~, and may or may not be connected to energy storage systems such as batteries~~ . These PV systems may have ac or dc output for utilization.

Informational Note No. 1: See Informational Note Figure 690.1(a) and Informational Note Figure 690.1(b).

Informational Note No.2: Article 691 covers the installation of large-scale PV electric supply stations.

Figure Informational Note Figure 690.1(a) Identification of PV Power Source Components.

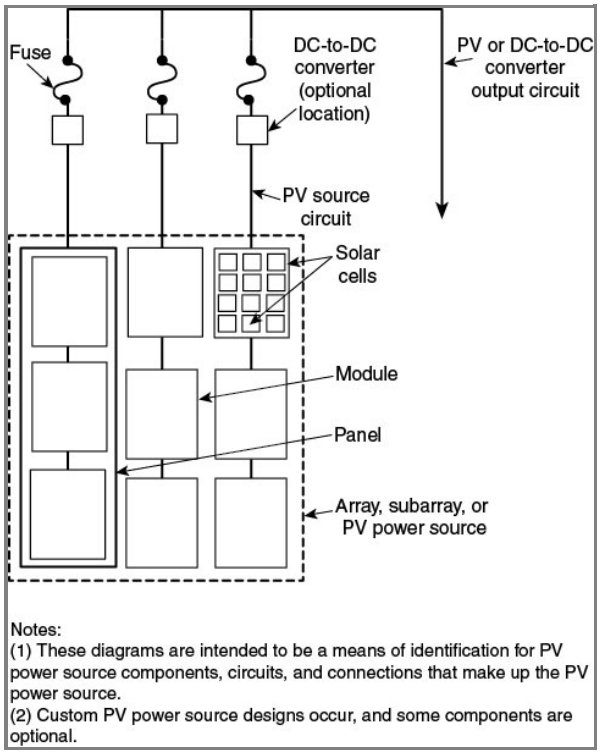
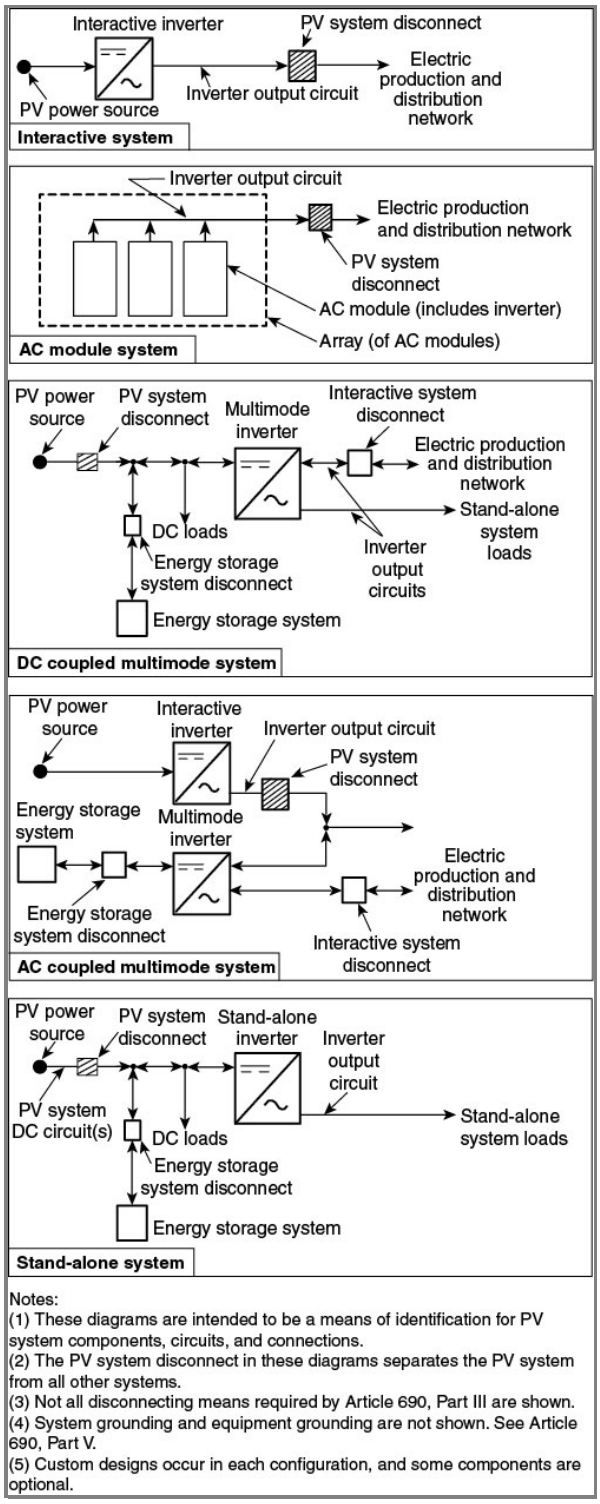


Figure Informational Note Figure 690.1(b) Identification of PV System Components in Common Configurations.



Notes:
(1) These diagrams are intended to be a means of identification for PV system components, circuits, and connections.
(2) The PV system disconnect in these diagrams separates the PV system from all other systems.
(3) Not all disconnecting means required by Article 690, Part III are shown.
(4) System grounding and equipment grounding are not shown. See Article 690, Part V.
(5) Custom designs occur in each configuration, and some components are optional.

Supplemental Information

File Name	Description	Approved
FR-8568_revised_Figure_690_1_a_and_b_word_version_.docx	revised figures 690.1(a) and (b) in word -- staff use only	✓
FR-8568_revised_Figure_690_1a_and_1b_PDF_version_.pdf	revised figures 690.1(a) and (b) in PDF -- staff use only	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 13:38:09 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The entire phrase about batteries has been removed as it is only one example of what a PV system may be connected to. It also clarifies the early part of the sentence to remove may and make this a more positive sentence.

These particular figures have been changed to informational notes since they are intended for informational purposes only and are not meant to dictate design standards or configurations. The terms in the figures where revised for consistency throughout articles under the purview of CMP-4.

Response Message:

Public Input No. 850-NFPA 70-2017 [Section No. 690.1]

Public Input No. 3496-NFPA 70-2017 [Section No. 690.1]

Public Input No. 3504-NFPA 70-2017 [Section No. 690.1]

Editorial Comment

Click here

First Revision No. 8517-NFPA 70-2018 [Definition: Alternating-Current (ac) Module (Alternating-Cu...]

Alternating-Current (ac) Module (Alternating-Current Photovoltaic Module).

A complete, environmentally protected unit consisting of solar cells, ~~optics,~~ inverter, and other components, ~~exclusive of tracker,~~ designed to generate ac power ~~when exposed to sunlight~~ .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 10:20:56 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Listings are required for ac modules in 690.4(B). The listing of an ac module defines what components are included in that piece of equipment. The term “optics” is unclear as it is not clearly defined nor is it necessary since it is not used for compliance with any other section of the NEC.

The term “tracker” is not required in this definition and can cause confusion. The remaining components listed in the revised definition outline the essential components of an ac module and are helpful for clarity. The phrase “when exposed to sunlight” is unnecessary and is not accurate since power generation from ac modules rely on other factors in addition to sunlight.

Public Input No. 3542-NFPA 70-2017 [Definition: Alternating-Current (ac) Module (Alternating-Cu...]

First Revision No. 8519-NFPA 70-2018 [Definition: Array.]

Array.

A mechanically and electrically integrated ~~assembly of module(s)~~ grouping of modules with support structure, including any attached system components such as inverter(s) or ~~panel(s)~~ dc-to-dc converter(s) ~~with a support structure and foundation, tracker, and other components, as required, to form a dc or ac power-producing unit~~ and attached associated wiring .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 10:29:07 EST 2018

Committee Statement and Meeting Notes

Committee Statement: As photovoltaic systems have increased in their size and complexity it has become necessary to modify the definition of “array”. Since the application of 690.12 Rapid Shutdown depends on a clear understanding of a PV array boundary, the added clarity will improve the understanding of this defined term and will benefit all stakeholders. The added phrase “and electrically” after “mechanically” as well as the term “grouping” is an effort to restrict the identification of array equipment to only equipment that is essential for the safe conversion of sunlight to electricity that is located at one location. Therefore an array should not include equipment that is only mechanically connected, nor should it included equipment that is only connected electrically (such as PV system equipment not mechanically attached to other PV system components in an array, such as inverters located elsewhere on the premises). Most PV systems will rely on PV module structural supports to support wiring, equipment, and often to provide an equipment grounding path. A “foundation” has been removed from this definition since this likely will have nothing to do with the electrical components of an array. The term “tracker” is not necessary compared to other support structures. Many PV systems will include power conditioning equipment mounted beneath PV modules that will alter the output wiring from PV arrays so inverters and dc-to-dc converters have specifically been added to this definition in the interest of clarity. Additionally “associated wiring” has been added as an array component since specific wiring methods are permitted within PV arrays per 690.31.

Response Message:

Public Input No. 3586-NFPA 70-2017 [Definition: Array.]

Editorial Comment

Click here

First Revision No. 8521-NFPA 70-2018 [Definition: Bipolar Photovoltaic Array.]

Bipolar ~~Photovoltaic Array~~ Circuits .

A dc ~~PV array that has two outputs~~ circuit that is comprised of two monopole subarray circuits , each having opposite polarity connected to a common reference point ~~or center tap~~ .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 10:40:42 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Section 690.2 includes a definition for monopole subarrays and how they are used to create a bipolar array. This change ties the definition of bipolar array to the use of monopole subarrays to make it more clear how they interrelate.

Removing the term “PV” broadens it out to include dc-to-dc converter bipolar arrays that are equally valid and should follow the same rules to limit overvoltages.

Response Message:

Public Input No. 4093-NFPA 70-2017 [Definition: Bipolar Photovoltaic Array.]

Public Input No. 1230-NFPA 70-2017 [Definition: Bipolar Photovoltaic Array.]

Editorial Comment

Click here

First Revision No. 8522-NFPA 70-2018 [Definition: DC-to-DC Converter Output Circuit.]

DC-to-DC Converter Output Circuit.

~~Circuit~~ The dc circuit conductors between the dc-to-dc converter source circuit(s) and the inverter or ~~dc utilization equipment~~ the dc PV system disconnecting means .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 10:45:59 EST 2018

Committee Statement and Meeting Notes

Committee Statement: DC utilization loads, feeders, or branch circuits are not part of a PV system so no reference to them shoup uld be included in this definition. Dc-to-dc Converter output circuits are dc only and will end at an inverter when that inverter is part of an ac PV system or at the PV system disconnecting means in a dc-only PV system.

Response Message:

Public Input No. 3610-NFPA 70-2017 [Definition: DC-to-DC Converter Output Circuit.]

Editorial Comment

Click here

First Revision No. 8525-NFPA 70-2018 [Definition: Direct-Current (dc) Combiner.]

Direct-Current (dc) Combiner.

A device used ~~in the PV source and PV output circuits to combine~~ to connect two or more dc ~~circuit inputs and provide one~~ PV system dc circuits in parallel, providing one or more dc circuit ~~output~~ output(s) .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 10:53:26 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Changing “combine” to “connect” clarifies that a dc combiner provides a “common connection point” as used in the definition of a photovoltaic source circuit. Shortening this definition removes redundancy with other definitions.

Response Message:

Public Input No. 3592-NFPA 70-2017 [Definition: Direct-Current (dc) Combiner.]

Public Input No. 3947-NFPA 70-2017 [Definition: Direct-Current (dc) Combiner.]

First Revision No. 8755-NFPA 70-2018 [Definition: Diversion Charge Controller.]

~~**Diversion Charge Controller.**~~

~~Equipment that regulates the charging process of a battery by diverting power from energy storage to direct-current or alternating-current loads or to an interconnected utility service.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 18:01:22 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The term is no longer used in Article 690.
Response Message:

First Revision No. 8527-NFPA 70-2018 [Definition: Electrical Production and Distribution Network.]

~~**Electrical Production and Distribution Network.**~~

~~A power production, distribution, and utilization system, such as a utility system and connected loads, that is external to and not controlled by the PV power system.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 10:58:24 EST 2018

Committee Statement and Meeting Notes

Committee Statement: A similar definition already exists in Article 100.
Response Message:

Public Input No. 3510-NFPA 70-2017 [Definition: Electrical Production and Distribution Network.]

First Revision No. 8734-NFPA 70-2018 [Definition: Functional Grounded PV System.]

~~**Functional** **Grounded PV System**~~ **, Functionally .**

A ~~PV~~ system that has an electrical ground reference ~~to ground~~ for operational purposes that is not solidly grounded.

Informational Note: ~~A functional grounded PV system is often connected to ground through a fuse, circuit breaker, resistance device, non-isolated grounded ac circuit, or electronic means that is part of a listed ground-fault protection system. Conductors in these systems that are normally at ground potential may have voltage to ground during fault conditions.~~ Examples of operational reasons for functionally grounded systems include ground-fault detection and performance-related issues for some power sources.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 16:02:09 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition is revised to follow the format in Article 100 as this definition is likely to be used in multiple articles such as 705, 706, and 712. Ground faults are only one of many reasons to functionally connect a circuit to ground. Potential induced degradation (PID) is another primary reason for functional grounding.

The informational note is revised to emphasize that ground fault protection is a common reason for functionally grounded systems.

Response Message:

Public Input No. 3524-NFPA 70-2017 [Definition: Functional Grounded PV System.]

Public Input No. 3995-NFPA 70-2017 [Definition: Functional Grounded PV System.]

Public Input No. 3581-NFPA 70-2017 [Definition: Functional Grounded PV System.]

Editorial Comment

Click here

First Revision No. 8532-NFPA 70-2018 [Definition: Generating Capacity.]

Generating Capacity, Inverter .

The sum of parallel-connected inverter maximum continuous output power at 40°C in kilowatts. (CMP-4)

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 11:19:56 EST 2018

Committee Statement and Meeting Notes

Committee Statement: "Inverter" was added to differentiate how the generating capacity may be defined for other types of generators not using an inverter. The definition is moved into Article 100 to be applicable in other articles.

Response Message:

Editorial Comment

Click here

First Revision No. 8531-NFPA 70-2018 [Definition: Interactive Inverter Output Circuit.]

~~**Interactive Inverter Output Circuit.**~~

~~The conductors between the interactive inverter and the service equipment or another electrical power production and distribution network.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 11:16:28 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This term is self-defined. The only usage in 690 is clear without the definition.
Response Message:

Public Input No. 3516-NFPA 70-2017 [Definition: Interactive Inverter Output Circuit.]

Public Input No. 852-NFPA 70-2017 [Definition: Interactive Inverter Output Circuit.]

Public Input No. 3852-NFPA 70-2017 [Definition: Interactive Inverter Output Circuit.]

First Revision No. 8536-NFPA 70-2018 [Definition: Interactive System.]

~~**Interactive System.**~~

~~A PV system that operates in parallel with and may deliver power to an electrical production and distribution network.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 11:25:54 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition is already present in Article 100.
Response Message:

Public Input No. 3853-NFPA 70-2017 [Definition: Interactive System.]

Public Input No. 4220-NFPA 70-2017 [Definition: Interactive System.]

Public Input No. 3513-NFPA 70-2017 [Definition: Interactive System.]

First Revision No. 8983-NFPA 70-2018 [Definition: Inverter Input Circuit.]

Inverter Input Circuit.

Conductors connected to the dc input of an inverter. (CMP-4)

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 25 09:48:26 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition is moved to Article 100.
Response Message:

Public Input No. 4252-NFPA 70-2017 [Definition: Inverter Input Circuit.]

Public Input No. 4250-NFPA 70-2017 [New Definition after Definition: Intrinsically Safe System ...]

First Revision No. 8984-NFPA 70-2018 [Definition: Inverter Output Circuit.]

Inverter Output Circuit.

Conductors connected to the ac output of an inverter. (CMP-4)

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 25 09:49:59 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition is moved to Article 100.
Response Message:

Public Input No. 4248-NFPA 70-2017 [New Definition after Definition: Intrinsically Safe System ...]

Public Input No. 4257-NFPA 70-2017 [Definition: Inverter Output Circuit.]

First Revision No. 8982-NFPA 70-2018 [Definition: Inverter.]

Inverter.

Equipment that ~~is used to change voltage level or waveform, or both, of electrical energy. Commonly, an inverter [also known as a power conditioning unit (PCU) or power conversion system (PCS)] is a device that~~ changes dc ~~input~~ to ~~an~~ ac ~~output. Inverters may also function as battery chargers that use alternating current from another source and convert it into direct current for charging batteries~~ . (CMP-4)

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 25 09:42:06 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition of inverter has been simplified to the minimum terminology so as not to limit the usage of the term and is moved to Article 100.

Response Message:

Public Input No. 1835-NFPA 70-2017 [New Definition after Definition: Interactive Inverter.]

Public Input No. 1834-NFPA 70-2017 [Definition: Inverter.]

Public Input No. 3854-NFPA 70-2017 [Definition: Inverter.]

Public Input No. 4235-NFPA 70-2017 [New Definition after Definition: Intrinsically Safe System ...]

Public Input No. 4234-NFPA 70-2017 [Definition: Inverter.]

Public Input No. 1229-NFPA 70-2017 [Definition: Inverter.]

First Revision No. 8550-NFPA 70-2018 [Definition: Module.]

Module.

A complete, environmentally protected unit consisting of solar cells ~~optics,~~ and other components ~~exclusive of tracker,~~ designed to generate dc power ~~when exposed to sunlight~~ .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 12:57:13 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision aligns the definition of module with the definition of ac module other than modules that have a dc output.
Response Message:

Editorial Comment

Click here

First Revision No. 8549-NFPA 70-2018 [Definition: Monopole Subarray.]

Monopole Subarray Circuit .

~~A PV subarray~~ An electrical subset of a PV system that has two conductors in the output circuit, one positive (+) and one negative (−). ~~Two monopole PV subarrays are used to form a bipolar PV array.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 12:53:38 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The term “subarray” has fallen out of use and is only used in reference to bipolar arrays. The concept is better captured in a single concept of the monopole subarray circuit. Any other subarray is simply a portion of an array and presently the term subarray is not used for a section of the array. Also, the term is only used in Article 690 in the context of bipolar arrays. Additional language is added to the second sentence to help the reader to understand how these subarrays are typically configured.

Response Message:

Public Input No. 4085-NFPA 70-2017 [Definition: Monopole Subarray.]

Editorial Comment

Click here

First Revision No. 8551-NFPA 70-2018 [Definition: Multimode Inverter.]

Multimode Inverter.

Equipment having the capabilities of both the interactive inverter and the stand-alone inverter. (CMP-4)

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 13:00:21 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This definition is in Articles 690 and 705 and has been moved to Article 100.
Response Message:

Public Input No. 3855-NFPA 70-2017 [Definition: Multimode Inverter.]

Public Input No. 2974-NFPA 70-2017 [Definition: Multimode Inverter.]

First Revision No. 8552-NFPA 70-2018 [Definition: Panel.]

~~**Panel.**~~

~~A collection of modules mechanically fastened together, wired, and designed to provide a field-installable unit.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 13:02:17 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The term is used differently in the field and the term adds no additional understanding on how to apply requirements in the few places it is used in Article 690. The building code uses the term.

Response Message:

Public Input No. 4081-NFPA 70-2017 [Definition: Panel.]

Public Input No. 683-NFPA 70-2017 [Definition: Panel.]

First Revision No. 8559-NFPA 70-2018 [Definition: Photovoltaic Output Circuit.]

Photovoltaic Output Circuit.

~~Circuit~~ The dc circuit conductors ~~between the PV source circuit(s) and the inverter or dc utilization~~ from the output of dc combiners connected to other equipment.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 13:20:49 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition is simplified to address conductors from combiners to other equipment. DC utilization loads, feeders, or branch circuits are not part of a PV system so reference to a connection with "other equipment" has been made.

Response Message:

Public Input No. 4140-NFPA 70-2017 [Section No. 690.2]

Public Input No. 3607-NFPA 70-2017 [Definition: Photovoltaic Output Circuit.]

Editorial Comment

Click here

First Revision No. 8563-NFPA 70-2018 [Definition: Photovoltaic Power Source.]

Photovoltaic Power Source.

An array or aggregate of arrays that generates dc power ~~at system voltage and current~~ .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 13:28:42 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Many PV power sources today have several different voltages and currents.
Response Message:

First Revision No. 8555-NFPA 70-2018 [Definition: Photovoltaic Source Circuit.]

Photovoltaic Source Circuit.

~~Circuits~~ The dc circuit conductors between modules and from modules to ~~the common connection point(s) of the dc system~~ dc combiners, electronic power converters, or the dc PV system disconnecting means .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 13:15:26 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition of PV source circuit is refined to address possible enforcement confusion in the application of the term throughout 690. The new term “electronic power converter” is used so that the list of devices is not necessary. The existing phrase, “the common connection point(s) of the dc system” is removed as it could be confused with parts of the dc output circuit.

Response Message:

Editorial Comment

Click here

First Revision No. 8557-NFPA 70-2018 [Definition: Photovoltaic System DC Circuit.]

Photovoltaic System DC Circuit.

Any dc conductor ~~supplied by~~ of a PV ~~power source~~ system , including PV source circuits, PV output circuits, dc-to-dc converter source circuits, ~~or~~ and dc-to-dc converter output circuits.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 13:17:43 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The phrase “supplied by a PV system” could be interpreted to include dc wiring outside of a PV system such as feeders or branch circuits if electrically connected to a PV system. The removal of this text restricts the usage of this term appropriately to only conductors within a PV system

Response Message:

Public Input No. 3608-NFPA 70-2017 [Definition: Photovoltaic System DC Circuit.]

First Revision No. 8565-NFPA 70-2018 [Definition: Stand-Alone System.]

~~**Stand-Alone System.**~~

~~A solar PV system that supplies power independently of an electrical production and distribution network.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 13:32:28 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This term is already defined in Article 100.
Response Message:

Public Input No. 3515-NFPA 70-2017 [Definition: Stand-Alone System.]

Public Input No. 4214-NFPA 70-2017 [Definition: Stand-Alone System.]

First Revision No. 8566-NFPA 70-2018 [Definition: Subarray.]

~~**Subarray.**~~

~~An electrical subset of a PV array.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 13:34:29 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This definition is no longer necessary. The term used in Article 690 is "monopole subarray" not "subarray".

Response Message:

Public Input No. 3595-NFPA 70-2017 [Definition: Subarray.]

Public Input No. 4091-NFPA 70-2017 [Definition: Subarray.]

First Revision No. 8520-NFPA 70-2018 [New Definition after Definition: Alternating-Current (ac) M...]

AC Module System.

An assembly of ac modules that is engineered, field-assembled, and field-installed using subassemblies and wiring methods supplied as a listed system by a singular entity that are matched and intended to be assembled as defined in the installation instructions.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 10:32:08 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This new definition for ac module systems supports the new language in 690.6 related to ac module systems. Manufacturers of PV system equipment are increasingly incorporating multiple array components into functional systems that are optimized for specific configurations. These systems will often need to be assembled in the field but would be restricted to specific configurations and equipment. Such designs may increase the reliability of PV systems.

Response Message:

Editorial Comment

Click here

First Revision No. 8526-NFPA 70-2018 [New Definition after Definition: Electrical Production and ...]

Electronic Power Converter.

A device that uses power electronics to convert one form of electrical power into another form of electrical power. These devices have limited current capabilities based on the device ratings at continuous rated power.

Informational Note: Examples of electronic power converters include, but are not limited to, inverters, dc-to-dc converters, and electronic charge controllers.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 10:56:13 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This new definition clarifies that many inverters and dc-to-dc converters are electronic power converters and the conductor sizing for these devices should be based on the ratings of the device and not the size of the PV array. It is possible to connect an array to an inverter that has twice the output current as the inverter. The only time the full current of the array is seen at the terminals of the inverter is if the inverter bridge short circuits. Because of this, if the conductors are sized based on the input current, an overcurrent device is necessary to protect the conductors in a fault condition.

Response Message:

Public Input No. 4077-NFPA 70-2017 [New Definition after Definition: Bipolar Photovoltaic Array.]

Editorial Comment

Click here

First Revision No. 8144-NFPA 70-2018 [Section No. 690.4(B)]

(B) Equipment.

Inverters, motor generators, PV modules, ~~PV panels,~~ ac modules and ac module systems , dc combiners, dc-to-dc converters, rapid shutdown equipment, dc circuit controllers, and charge controllers intended for use in PV systems shall be listed or field labeled for the ~~PV~~ application.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 09:38:24 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Equipment that is listed or field labeled for the application means that it is intended for use in that application. The use of the term “PV” is unnecessary, since these components are either covered by PV standards or are governed by different standards. Examples of equipment that are may be governed by different standards include components such as ac disconnects, ac overcurrent protection, wiring devices, and motor generators. The term dc controller is added to allow for devices other than dc-to-dc converters to be required to be listed for PV systems.

Rapid shutdown equipment such as isolating relays may be used for rapid shutdown and arc-fault applications but can be applied for other protective and isolating functions. When intended for use in PV systems, these devices should have an evaluation that addresses environment, use conditions, and PV-specific electrical considerations. The term PV panel has been removed since the definition has been removed and it could be misconstrued that all panalization of PV modules must be listed which is not the case.

Response Message:

Public Input No. 4313-NFPA 70-2017 [Section No. 690.4(B)]

Public Input No. 3526-NFPA 70-2017 [Section No. 690.4(B)]

First Revision No. 8754-NFPA 70-2018 [New Section after 690.4(E)]

(F) Electronic Power Converters Mounted in Not Readily Accessible Locations.

Electronic power converters and their associated devices shall be permitted to be mounted on roofs or other exterior areas that are not readily accessible. Disconnecting means shall be installed in accordance with 690.15.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 17:47:04 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The requirements for equipment disconnecting means for equipment used in PV systems belong in Article 690. This change clarifies that this EPC's such as inverters and dc-to-dc converters may be mounted in not readily accessible locations. This is consistent with the deletion of 705.70. This change does not eliminate the requirement for a PV system disconnecting means in a readily accessible location per 690.13, nor the requirement for identification of power source disconnecting means per 705.10.

Response Message:

Editorial Comment

Click here

First Revision No. 8152-NFPA 70-2018 [Section No. 690.6]

690.6 Alternating-Current (ac) Modules and Systems .

(A) Photovoltaic Source Circuits.

The requirements of Article 690 pertaining to PV source circuits shall not apply to ac modules or ac module systems . The PV source circuit, conductors, and inverters shall be considered as internal components of an ac module or ac module system. The PV source circuit, conductors, and inverters shall be considered as internal wiring of an ac module.

(B) ~~Inverter~~ Output Circuit.

The output of an ac module or ac module system shall be considered an inverter output circuit.

(C) Flexible Harnesses and Cables.

Flexible wiring harnesses and cables in ac module and ac module systems shall be installed in accordance with the instructions included with the listed or labeled equipment. Where not otherwise specified in their instructions, they shall be installed in accordance with the following:

(1) Where not protected by raceways they shall be limited to rooftop locations

(2) Shall closely follow the surface(s) to which they are adjacent

(3) Shall be protected from physical damage where necessary

(4) Shall be secured or supported, at a minimum, every 1.4 m (4½ ft) and within 300 mm (12 in.) of every connector. Sections of cords or cables protected from physical protection by raceways shall not be required to be secured within the raceway

Exception: Larger support spacings are permitted as defined elsewhere in this Code for the specific wiring method.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 10:04:55 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Pre-engineered ac module systems will have components specified in their instructions that will interconnect multiple ac modules into a system with a single output circuit. This output circuit from such a system should be treated like an inverter output circuit just like a single ac module's output is. All dc and ac wiring up to the system termination point, as identified in its instructions, should be considered internal to the system. Considerations for ampacity, disconnection, and other requirements that generally apply to the interconnection of multiple ac modules will have been addressed in the pre-engineering of the system. Since these systems may utilize cable types that are not otherwise covered in the Code, specific requirements for these wiring methods have been added to this section to cover situations where these methods have not been clearly outlined in the listed instructions.

Equipment such as inverters are considered to be a component, not wiring. The word “components” is more inclusive and clear. The change (B) is stylistic and clarifies that the output circuit of an ac module is an inverter output circuit.

Response Message:

Public Input No. 3781-NFPA 70-2017 [New Section after 690.4(E)]

Public Input No. 4217-NFPA 70-2017 [New Section after 690.6]

Public Input No. 3596-NFPA 70-2017 [Section No. 690.6]

Public Input No. 4127-NFPA 70-2017 [New Article after 100]

Public Input No. 3782-NFPA 70-2017 [New Section after 690.4(E)]

Editorial Comment

Click here

First Revision No. 8165-NFPA 70-2018 [Section No. 690.7(A)]

(A) Photovoltaic Source and Output Circuits.

In a dc PV source circuit or output circuit, the maximum PV system voltage for that circuit shall be calculated in accordance with one of the following methods:

Informational Note: One source for lowest-expected, ambient temperature design data for various locations is the chapter titled Extreme Annual Mean Minimum Design Dry Bulb Temperature found in the *ASHRAE Handbook — Fundamentals,* 2013. These temperature data can be used to calculate maximum voltage.

(1) ~~Instructions in listing or labeling of the module~~ Module instructions : The sum of the PV module–rated open-circuit voltage of the series-connected modules corrected for the lowest expected ambient temperature using the open-circuit voltage temperature coefficients in accordance with the instructions included in the listing or labeling of the module.

(2) ~~Crystalline~~ Table for crystalline and multicrystalline modules: For crystalline and multicrystalline silicon modules, the sum of the PV module–rated open-circuit voltage of the series-connected modules corrected for the lowest expected ambient temperature using the correction factor provided in Table 690.7(A).

(3) ~~PV systems of 100 kW or larger~~ Engineered industry standard method : For PV systems with ~~a~~ an inverter generating capacity of 100 kW or greater, a documented and stamped PV system design, using an industry standard method and provided by a licensed professional electrical engineer, shall be permitted.

Informational Note: One industry standard method for calculating maximum voltage of a PV system is published by Sandia National Laboratories, reference SAND 2004-3535, *Photovoltaic Array Performance Model*.

~~The maximum voltage shall be used to determine the voltage rating of conductors, cables, disconnects, overcurrent devices, and other equipment.~~

Table 690.7(A) Voltage Correction Factors for Crystalline and Multicrystalline Silicon Modules

Correction Factors for Ambient Temperatures Below 25°C (77°F). (Multiply the rated open-circuit voltage by the appropriate correction factor shown below.)		
Ambient Temperature (°C)	**Factor**	**Ambient Temperature (°F)**
24 to 20	1.02	76 to 68
19 to 15	1.04	67 to 59
14 to 10	1.06	58 to 50
9 to 5	1.08	49 to 41
4 to 0	1.10	40 to 32
–1 to –5	1.12	31 to 23
–6 to –10	1.14	22 to 14
–11 to –15	1.16	13 to 5
–16 to –20	1.18	4 to –4
–21 to –25	1.20	–5 to –13
–26 to –30	1.21	–14 to –22
–31 to –35	1.23	–23 to –31
–36 to –40	1.25	–32 to –40

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04

Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 10:51:08 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The changes to the list headings are more accurate and consistent with one another. The last sentence was moved to the charging paragraph of 690.7(A).

The revision to text is to align with the revised definition of "inverter generating capacity" in Article 100.

Response Message:

Public Input No. 3856-NFPA 70-2017 [Section No. 690.7(A)]

Editorial Comment

Click here

First Revision No. 8179-NFPA 70-2018 [Section No. 690.7(B)(1)]

(1) Single DC-to-DC Converter.

For circuits connected to the output of a single dc-to-dc converter, the maximum voltage shall be determined in accordance with the instructions included in the listing or labeling of the dc-to-dc converter. If the instructions do not provide a method to determine the maximum voltage, the maximum voltage shall be the maximum rated voltage output of the dc-to-dc converter.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 11:27:10 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The first revision provides parallel construction between 690.7(B)(1) and (2).
Response Message:

Public Input No. 410-NFPA 70-2017 [Section No. 690.7(B)(1) Single ...]

First Revision No. 8183-NFPA 70-2018 [Section No. 690.7(B)(2)]

(2) Two or More Series-Connected DC-to-DC Converters.

For circuits connected to the output of two or more series-connected dc-to-dc converters, the maximum voltage shall be determined in accordance with the instructions included in the listing or labeling of the dc-to-dc converter. If ~~these~~ the instructions do not ~~state the rated voltage of series-connected dc-to-dc converters~~ provide a method to determine the maximum voltage , the maximum voltage shall be the sum of the maximum rated voltage output of the dc-to-dc converters in series.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 11:30:14 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The first revision revises 690.7(B)(2) for clarity and parallel construction with (B)(1).

Response Message:

Public Input No. 399-NFPA 70-2017 [Section No. 690.7(B)(2) Two or ...]

Editorial Comment

Click here

First Revision No. 8168-NFPA 70-2018 [Section No. 690.7(C)]

(C) Bipolar Source and Output Circuits.

For ~~2-wire dc circuits connected to bipolar PV arrays~~ monopole subarrays in bipolar systems , the maximum voltage shall be the highest voltage between the ~~2-wire~~ monopole subarray circuit conductors where one conductor of the ~~2-wire~~ monopole subarray circuit is connected to the ~~functional ground reference (center tap)~~ functionally grounded reference . To prevent overvoltage in the event of a ground fault or arc fault, the ~~array~~ monopole subarray circuits shall be isolated from ~~the~~ ground ~~reference and isolated into two 2-wire circuits~~ .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 10:59:53 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The use of the defined term “monopole subarray” in place of 2-wire circuits adds clarity and simplifies the language.

The term "PV" could cause someone to restrict the use of dc-to-dc converter arrays and has been removed. The term “functional ground reference” is adjusted to “functionally grounded reference” to parallel other usage in Article 690. The term “center tap” is removed as the tap may not be in the center.

Response Message:

Public Input No. 4096-NFPA 70-2017 [Section No. 690.7(C)]

Public Input No. 1231-NFPA 70-2017 [Section No. 690.7(C)]

Editorial Comment

Click here

First Revision No. 8158-NFPA 70-2018 [Section No. 690.7 [Excluding any Sub-Sections]]

The maximum voltage of PV system dc circuits shall be the highest calculated voltage between any two circuit conductors or any conductor and ground. The maximum voltage shall be used to determine the voltage and voltage to ground of circuits in the application of this *Code* . Maximum voltage shall be used for conductors, cables, equipment, working space, and other applications where voltage limits and ratings are used.

PV system dc circuits on or in one- and two-family dwellings shall be permitted to have a maximum voltage ~~of 600 volts or less. PV system dc~~ no greater than 1000 volts. PV source and output circuits on or in ~~other types of buildings~~ one- and two-family dwellings shall be permitted to have a maximum voltage ~~of 1000 volts or less~~ no greater than 600 volts . Where not located on or in buildings, listed dc PV equipment, rated at a maximum voltage ~~of 1500 volts or less~~ no greater than 1500 volts , shall not be required to comply with Parts II and III of Article 490.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 10:27:29 EST 2018

Committee Statement and Meeting Notes

Committee Statement: There is a potential for confusion when applying voltage and voltage to ground requirements throughout this Code as it relates to dc PV system circuits. To clarify how voltage is to be used, the statement in the sentence at the end of 690.7(A) is moved to the initial charging paragraph as examples of how maximum voltage is to be applied. Added to the previous list is working space to clarify this use for 110.26.

The term “or less” after volts is replaced with the term, “no greater than” before the voltage value to better conform with other uses in the NEC.

This revision allows single circuits for dc-to-dc converter circuits to operate at 1000V on one- and two-family dwellings. Adding language to reference to 1000 volts ensures that PV source and output circuits are limited to 600V as the Code has required previously.

Response Message:

Public Input No. 353-NFPA 70-2017 [Section No. 690.7 [Excluding any Sub-Sections]]

Public Input No. 3849-NFPA 70-2017 [Section No. 690.7 [Excluding any Sub-Sections]]

Public Input No. 3850-NFPA 70-2017 [Section No. 690.7 [Excluding any Sub-Sections]]

Public Input No. 2853-NFPA 70-2017 [Section No. 690.7 [Excluding any Sub-Sections]]

Public Input No. 3851-NFPA 70-2017 [Section No. 690.7(A)]

Editorial Comment

Click here

First Revision No. 8194-NFPA 70-2018 [New Section after 690.8(A)(1)]

(2) Currents of Circuits Connected to the Input of Electronic Power Converters.

The maximum current for a PV system dc circuit connected to the input of an electronic power converter shall be permitted to be the lesser of the rated input current of the converter, or the current as calculated in 690.8(A)(1) and (A)(3). Where the rated input current of the converter is not provided in the manufacturer's instructions, the rated input current shall be the current at the lowest input voltage in which the device converts continuous rated output power.

Where multiple PV system dc circuits are connected to a single electronic power converter input, the maximum current per circuit shall be the rated input current of the converter divided by the number of circuits connected to the input.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 12:31:30 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The addition of (A)(2) covers the case in existing (A)(4). The last sentence in (A)(2) makes it clear that the maximum current does not need to be greater than (A)(1).

This addresses adjustable trip devices and makes it work generically whether the device is adjustable or not. This new paragraph allows for a 1000-amp input on an inverter to be supplied by five 200-amp PV output circuits each with 250-amp overcurrent devices. Each conductor would be sized for a minimum ampacity of 250-amps before the application of adjustment and correction factors [690.8(B)]. The newly defined term, electronic power converters (See FR-8526), is used to refer to multiple devices in PV systems that have limited input current.

Response Message:

Public Input No. 4025-NFPA 70-2017 [New Section after 690.8(A)(1)]

Editorial Comment

Click here

First Revision No. 8756-NFPA 70-2018 [Section No. 690.8(A)(1)]

(1) Photovoltaic Source Circuit Currents.

The maximum current shall be ~~calculated by one of the following methods:~~ as calculated in 690.8(A)(1)(1) , or where meeting the associated restrictions, as permitted in accordance with either 690.8(A)(1)(2) or 690.8(A)(2).

(1) The sum of parallel-connected PV module–rated short-circuit currents multiplied by 125 percent

(2) For PV systems with ~~a~~ an inverter generating capacity of 100 kW or greater, a documented and stamped PV system design, using an industry standard method and provided by a licensed professional electrical engineer, shall be permitted. The calculated maximum current value shall be based on the highest 3-hour current average resulting from the simulated local irradiance on the PV array accounting for elevation and orientation. The current value used by this method shall not be less than 70 percent of the value calculated using 690.8(A)(1)(1).

Informational Note: One industry standard method for calculating maximum current of a PV system is available from Sandia National Laboratories, reference SAND 2004-3535, *Photovoltaic Array Performance Model*. This model is used by the System Advisor Model simulation program provided by the National Renewable Energy Laboratory.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 18:29:24 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Clarification is added to 690.8(A)(1) that calculations for these circuits have options. However, the secondary options in 690.8(A)(2) and 690.8(A)(1)(2) contain restrictions.

The term “an inverter” is added before generating capacity in 690.8(A)(1)(2) for consistency with the revised definition of “inverter generating capacity.”

Response Message:

Editorial Comment

Click here

First Revision No. 8202-NFPA 70-2018 [Section No. 690.8(A)(2)]

(3) Photovoltaic Output Circuit Currents.

The maximum current shall be the sum of parallel source circuit maximum currents as calculated in 690.8(A)(1) or (A)(2) .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 13:05:36 EST 2018

Committee Statement and Meeting Notes

Committee Statement: New section 690.8(A)(2) allows for a different calculation, other than (A)(1) to be used.

Response Message:

Public Input No. 4026-NFPA 70-2017 [Section No. 690.8(A)(2)]

First Revision No. 8208-NFPA 70-2018 [Section No. 690.8(A)(4)]

~~**(5)** Stand-Alone Inverter Input Circuit Current.~~

~~The maximum current shall be the stand-alone continuous inverter input current rating when the inverter is producing rated power at the lowest input voltage.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 13:21:37 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The stand-alone inverter input circuit is not part of the PV system and should not be included in Article 690. The method of current calculation is captured in new 690.(A)(2). See FR-8194.

Response Message:

Public Input No. 4029-NFPA 70-2017 [Section No. 690.8(A)(4)]

First Revision No. 8210-NFPA 70-2018 [Section No. 690.8(A)(6)]

(6) DC-to-DC Converter Output Circuit Current.

The maximum current shall be the sum of parallel connected dc-to-dc converter source circuit currents as calculated in ~~690.8(A)(6)~~ 690.8(A)(2) or (A)(5) .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 13:25:57 EST 2018

Committee Statement and Meeting Notes

Committee Statement: New section 690.8(A)(2) allows for a different calculation, other than (A)(5) to be used. This requires addition of 690.8(A)(2) to the this section.

Response Message:

Public Input No. 4030-NFPA 70-2017 [Section No. 690.8(A)(6)]

First Revision No. 8172-NFPA 70-2018 [Section No. 690.8(A) [Excluding any Sub-Sections]]

The maximum current for the specific circuit shall be calculated in accordance with 690.8(A)(1) through (A)(6).

~~Informational Note: Where the requirements of 690.8(A)(1) and (B)(1) are both applied, the resulting multiplication factor is 156 percent.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 11:09:14 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This note is now not correct given the existence of 690.8(A)(1)(2). The 1.56 factor also is problematic from the standpoint of proper application because the two factors that are combined in this note are often confused by installers.

Response Message:

Public Input No. 4021-NFPA 70-2017 [Section No. 690.8(A) [Excluding any Sub-Sections]]

First Revision No. 8213-NFPA 70-2018 [Section No. 690.8(B)]

(B) Conductor Ampacity.

~~PV system currents shall be considered to be continuous.~~ Circuit conductors shall be sized to carry not less than the larger of 690.8(B)(1) or (B)(2) ~~or where protected by a listed adjustable electronic overcurrent protective device in accordance~~ 690.9(B)(3) ~~, not less than the current in~~ 690.8(B)(3) .

(1) ~~Before Application of~~ Without Adjustment and Correction Factors.

~~One hundred twenty-five percent of the~~ The maximum currents calculated in 690.8(A) ~~before the application of adjustment and~~ multiplied by 125 percent without adjustment or correction factors.

Exception: Circuits containing an assembly, together with its overcurrent device(s), that is listed for continuous operation at 100 percent of its rating shall be permitted to be used at 100 percent of its rating.

(2) ~~After Application of~~ With Adjustment and Correction Factors.

The maximum currents calculated in 690.8(A) ~~after the application of~~ with adjustment and correction factors.

~~**(3)** Adjustable Electronic Overcurrent Protective Device.~~

~~The rating or setting of an adjustable electronic overcurrent protective device installed in accordance with 240.6 .~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 13:42:21 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The first sentence of the 690.8(B) has been deleted as unnecessary since continuous calculations are required by (B)(1) and (B)(2). Section 690.8(B)(1) is reorganized to turn the spelled-out percentage into a number.

The titles of (1) and (2) are shortened to categorize calculations with and without adjustment and correction factors. The terms “before” and “after” are intended to address time in the way “when” addresses time.

Section 690.8(B)(3) is deleted as it is no longer needed with the revisions related to circuits connected to electronic power converters.

Response Message:

Public Input No. 1959-NFPA 70-2017 [Section No. 690.8(B)]

Public Input No. 405-NFPA 70-2017 [Section No. 690.8(B)]

Public Input No. 1071-NFPA 70-2017 [Section No. 690.8(B)(1)]

Public Input No. 1070-NFPA 70-2017 [Section No. 690.8(B)(1)]

Public Input No. 1232-NFPA 70-2017 [Section No. 690.8(B)]

Public Input No. 2577-NFPA 70-2017 [Sections 690.8(B)(1), 690.8(B)(2)]

Public Input No. 4049-NFPA 70-2017 [Section No. 690.8(B)]

First Revision No. 8226-NFPA 70-2018 [Section No. 690.9(A)]

(A) Circuits and Equipment.

PV system dc circuit and inverter output conductors and equipment shall be protected against overcurrent. ~~Overcurrent protective devices shall not be required for circuits with sufficient ampacity for the highest available current. Circuits connected to current limited supplies (e.g., PV modules, dc-to-dc converters, interactive inverter output circuits) and also connected to sources having higher current availability (e.g., parallel strings of modules, utility power) shall be protected at the higher current source connection.~~ Circuits sized in accordance with 690.8(A)(2) are required to protected against overcurrent with overcurrent protective devices. Each circuit shall be protected from overcurrent in accordance with 690.9(A)(1), (A)(2), or (A)(3).

~~*Exception: An overcurrent device shall not be required for PV modules or PV source circuit or dc-to-dc converters source circuit conductors sized in accordance with 690.8(B) where one of the following applies:*~~

~~*(0) There are no external sources such as parallel-connected source circuits, batteries, or backfeed from inverters.*~~

~~*(0) The short-circuit currents from all sources do not exceed the ampacity of the conductors and the maximum overcurrent protective device size rating specified for the PV module or dc-to-dc converter.*~~

(1) Circuits Where Overcurrent Protection Not Required.

Overcurrent protective devices shall not be required where both of the following conditions are met:

(1) The circuits have sufficient ampacity for the maximum circuit current.

(2) The currents from all sources do not exceed the maximum overcurrent protective device rating specified for the PV module or electronic power converter.

(2) Circuits Connected to Source of Overcurrent on One End.

Circuits connected to current-limited supplies (e.g., PV modules, electronic power converters, interactive inverter output circuits) and also connected to sources having higher current availability (e.g., parallel strings of modules, utility power), that are a source of overcurrent, shall be protected at the higher current source connection.

Informational Note: Photovoltaic system dc circuits are current-limited circuits ~~that only~~ and may not need overcurrent protection ~~when~~ . When connected in parallel to higher current sources, ~~. The~~ such as parallel-connected PV system dc circuits, batteries, or backfeed from inverters, the overcurrent device is often installed at the higher current source end of the circuit.

(3) Circuits Connected to Sources of Overcurrent on Both Ends.

Circuits that do not comply with 690.9(A)(1) or (A)(2) and with sources of overcurrent on both ends of a conductor shall be protected with one of the following methods:

(1) Conductors not greater than 3 m (10 ft) in length and protected from overcurrent on one end

(2) Conductors protected from overcurrent on both ends

(3) Conductors not installed on or in buildings are permitted to be protected from overcurrent on one end of the circuit where the circuit complies with all of the following conditions:

a. The conductors are installed in metal raceways or metal-clad cables, or installed in enclosed metal cable trays, or underground, or where directly entering pad-mounted enclosures.

b. The conductors for each circuit terminate on one end at a single circuit breaker or a single set of fuses that limit the current to the ampacity of the conductors.

c. The overcurrent device for the conductors is an integral part of a disconnecting means or shall be located within 3 m (10 ft) of conductor length of the disconnecting means.

d. The disconnecting means for the conductors is installed outside of a building, or at a readily accessible location nearest the point of entrance of the conductors inside of a building, including installations complying with 230.6.

Supplemental Information

File Name	Description	Approved
Panel_4_FR-8226_690.9_A_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 14:40:54 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision reorganizes 690.9(A) to eliminate the two exceptions and place them in positive language in 690.9(A)(1). Clarifying language in Exception (1) is moved into the informational note. A list of three categories are made for unique and different protection scenarios. Section 690.9(A)(2) addresses circuits connected to current limited sources.

Section 690.9(A)(3) addresses circuits with sources of overcurrent on both ends with three protection options

Section 690.9(A)(3)(1) permits short conductor lengths to be protected from overcurrent on one end. Short conductors are common when installing combiner boxes next to inverters and this language will reduce the need for fuses on both ends of a short wire. The “tap rule” in 240.21(B) is an example where the 10’ length is used for feeder taps with remove overcurrent protection.

Section 690.9(A)(3)(2) covers conductors in general with sources of overcurrent on both ends as they would require overcurrent protection on both ends as required by Article 240.

Section 690.9(A)(3)(3) addresses longer runs with overcurrent on one end where the conductors are located outside of building. Since conductors in PV systems have very limited short circuit current on at least one end of the conductor, overcurrent protection is typically located on one of the circuit. With the new language related to inputs to electronic conversion devices, many dc circuits will be required to overcurrent protection on both ends of the circuit when on buildings and greater than 10’ in length (690.9(A)(3)(1).

The new 690.9(A)(3)(3) allows for ground-mounted systems to apply overcurrent protection where it will do the most good. Other safeties to prevent conductor faults are required such as ground-fault and arc-fault detection to further reduce the need for overcurrent protection on both ends of the circuit. This new section allows oversized PV arrays to be connected to inverters with overcurrent protection on the inverter side of the circuit as it has been done for many years. The detailed requirements are modeled after outdoor transformer secondary conductor requirements in 240.21(C)(4).

Response Message:

Public Input No. 1283-NFPA 70-2017 [Section No. 690.9(A)]

Public Input No. 4055-NFPA 70-2017 [Section No. 690.9(A)]

Public Input No. 4066-NFPA 70-2017 [New Section after 690.9(C)]

Editorial Comment

Click here

First Revision No. 8232-NFPA 70-2018 [Section No. 690.9(B)]

(B) ~~Overcurrent~~ Device Ratings.

Overcurrent devices used in PV system dc circuits shall be listed for use in PV systems. Electronic devices that are listed to prevent backfeed current in PV system dc circuits shall be permitted to prevent overcurrent of conductors on the PV array side of the device. Overcurrent devices, where required, shall be rated in accordance with one of the following:

(1) Not less than 125 percent of the maximum currents calculated in 690.8(A).

(2) An assembly, together with its overcurrent device(s), that is listed for continuous operation at 100 percent of its rating shall be permitted to be used at 100 percent of its rating.

(3) ~~Adjustable electronic overcurrent protective devices rated or set in accordance with 240.6 .~~ Where a PV system dc circuit is connected to the input of an electronic power converter and the ampacity of the conductor is less than the current calculated in 690.8(A)(1), the conductor shall be protected with an overcurrent protective device rated or set not greater than the ampacity of the conductor. Conductor lengths of 3 m (10 ft) or less are permitted to be protected with a single overcurrent device located on one end of the conductor.

Informational Note: Some electronic ~~overcurrent~~ protective devices prevent backfeed current, which may be the only source of overcurrent in some PV system dc circuits .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 15:00:02 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The title of (B) has been changed to generically deal with device ratings related to overcurrent protection, the subject of 690.9. Backfeed prevention devices may have a zero ampere reverse current rating and have been added to 690.9(B).

Item 3 is rewritten to address all circuits connected to electronic power converters and reiterates the need to protect the conductor with an overcurrent device rated at the ampacity of the conductor. The second sentence permits short conductor lengths to be protected from overcurrent on one end. Short conductors are common when installing combiner boxes next to inverters and this language will prevent the wasteful practice of putting fuses on either end of a 3' wire. New Section 690.9(D) addresses longer runs with overcurrent on one end where the conductors are located outside of building.

The informational note is expanded to help the reader understand that backfeed current is often the only source of overcurrent in a PV source or output circuit and to provide additional understanding of current flows in PV system dc circuits.

Response Message:

Public Input No. 4058-NFPA 70-2017 [Section No. 690.9(B)]

Public Input No. 406-NFPA 70-2017 [Section No. 690.9(B)]

Public Input No. 4045-NFPA 70-2017 [Section No. 690.9(C)]

Public Input No. 3933-NFPA 70-2017 [Section No. 690.9(B)]

Editorial Comment

Click here

First Revision No. 8233-NFPA 70-2018 [Section No. 690.9(C)]

(C) ~~Photovoltaic~~ Source and Output Circuits.

A single overcurrent protective device, where required, shall be permitted to protect the PV modules, dc-to-dc converters, and conductors of each source circuit or the conductors of each output circuit. Where single overcurrent protection devices are used to protect ~~PV~~ source or output circuits, all overcurrent devices shall be placed in the same polarity for all circuits within a PV system. The overcurrent devices shall be accessible but shall not be required to be readily accessible.

Informational Note: Due to improved ground-fault protection required in PV systems by 690.41(B), a single overcurrent protective device in either the positive or negative conductors of a PV system in combination with this ground-fault protection provides adequate overcurrent protection.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 15:07:24 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision provides a broader application related to protection of source and output circuits since the Article 690 has provided much more detail about dc-to-dc converter circuits. There is little or no difference in the methods to protect all source and output circuits so this section no longer needs to be about PV system circuit.

First Revision No. 8239-NFPA 70-2018 [Section No. 690.11]

690.11 Arc-Fault Circuit Protection (Direct Current).

Photovoltaic systems operating at 80 volts dc or greater between any two conductors shall be protected by a listed PV arc-fault circuit interrupter or other system components listed to provide equivalent protection. The system shall detect and interrupt arcing faults resulting from a failure in the intended continuity of a conductor, connection, module, or other system component in the PV system dc circuits.

Informational Note: Annex A includes the reference for the Photovoltaic DC Arc-Fault Circuit Protection product standard.

Exception: For PV systems not installed on or in buildings, PV output circuits and dc-to-dc converter output circuits that are ~~direct buried,~~ installed in metallic raceways or metal-clad cables , or installed in enclosed metallic cable trays, or are underground are permitted without arc-fault circuit protection. Detached structures whose sole purpose is to house PV system equipment shall not be considered buildings according to this exception.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 15:41:27 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Changes to existing language enhance clarity by adding “or” and putting metallic raceways and cable trays in the same clause. Any underground wiring method is permitted which is the original intent of this language and of the term “direct-buried” in 300.5. The 2017 language could be misconstrued to mean that underground conduit would not be permitted with this exception which is not the intention of the exception.

Response Message:

Public Input No. 1225-NFPA 70-2017 [Section No. 690.11]

Public Input No. 2855-NFPA 70-2017 [Section No. 690.11]

Editorial Comment

Click here

First Revision No. 8242-NFPA 70-2018 [Section No. 690.12(A)]

(A) Controlled Conductors.

Requirements for controlled conductors shall apply to ~~PV circuits supplied by the PV system.~~ the following:

(1) PV system dc circuits

(2) Inverter output circuits originating from inverters located within the array boundary

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 15:52:32 EST 2018

Committee Statement and Meeting Notes

Committee Statement: In the new list of controlled conductors the defined term "PV system dc circuits" is used to clarify that these circuits, regardless of subtype, must be controlled. Additionally any ac inverter output circuits that originate within the array boundary are also required to be controlled. Clearly defining these circuits ensures that any devices used to perform rapid shutdown, either dc and ac devices, requires a unique evaluation and listing to provide rapid shutdown.

Response Message:

Public Input No. 2778-NFPA 70-2017 [Section No. 690.12(A)]

Editorial Comment

Click here

First Revision No. 8253-NFPA 70-2018 [Section No. 690.12(B)(2)]

(2) Inside the Array Boundary.

The PV system shall comply with one of the following:

(1) ~~The PV array shall be listed or field labeled as a rapid shutdown PV array. Such a PV array~~ Provide shock hazard control for emergency responders through the use of a PV hazard control means listed for the purpose. The hazard control components shall be installed and used in accordance with the instructions included with the ~~rapid shutdown PV array~~ listing or field labeling.

Informational Note: A listed or field-labeled ~~rapid shutdown PV array is evaluated as an assembly or system as defined in the installation instructions to reduce but not eliminate risk of electric shock hazard within a damaged PV array during fire-fighting procedures. These rapid shutdown PV arrays are designed to reduce shock hazards by methods such as limiting access to energized components, reducing the voltage difference between energized components, limiting the electric current that might flow in an electrical circuit involving personnel with increased resistance of the conductive circuit, or by a combination of such methods.~~ hazard control system may be comprised of either an individual piece of equipment that fulfills the necessary functions, or multiple pieces of equipment coordinated to perform the functions as described in the installation instructions to reduce the risk of electric shock hazard within a damaged PV array for fire fighters.

(2) Controlled conductors located inside the boundary ~~or not more than 1 m (3 ft) from the point of penetration of the surface of the building~~ shall be limited to not more than 80 volts within 30 seconds of rapid shutdown initiation. Voltage shall be measured between any two conductors and between any conductor and ground.

(3) PV arrays with no exposed wiring methods, no exposed conductive parts, and installed more than 2.5 m (8 ft) from exposed grounded conductive parts or ground shall not be required to comply with 690.12(B)(2).

~~The requirement of 690.12(B)(2) shall become effective January 1, 2019.~~

Supplemental Information

File Name	Description	Approved
Panel_4_FR-8253_690.12_B_2_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 16:22:17 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Changes are made to 690.12(B)(2)(1) and its informational note to further align the text with ongoing efforts to develop a new product safety standard to address this requirement. The language in 690.12(B)(2)(2) identifying distances is removed since it is unnecessary and could create confusion as these distances are already stated in 690.12(B)(1). The remaining language in 690.12(B)(2)(2) and 690.12(B)(2)(3) remains unchanged to support existing products. The delayed enforcement date has been removed since it occurs prior to the publication of NFPA-70 2020 revision

Response Message:

Public Input No. 3929-NFPA 70-2017 [Section No. 690.12(B)(2)]

Public Input No. 4143-NFPA 70-2017 [Section No. 690.12(B)(2)]

Public Input No. 3741-NFPA 70-2017 [Section No. 690.12(B)]

Public Input No. 2780-NFPA 70-2017 [Section No. 690.12(B)(2)]

Public Input No. 402-NFPA 70-2017 [Section No. 690.12(B)(2)]

Public Input No. 2779-NFPA 70-2017 [Section No. 690.12(B)(2)]

Public Input No. 401-NFPA 70-2017 [Section No. 690.12(B)(2)]

Public Input No. 3863-NFPA 70-2017 [Section No. 690.12(B)(2)]

Public Input No. 3259-NFPA 70-2017 [Section No. 690.12(B)(2)]

Public Input No. 793-NFPA 70-2017 [Section No. 690.12(B)(2)]

Public Input No. 2990-NFPA 70-2017 [Section No. 690.12]

Editorial Comment

Click here

First Revision No. 8249-NFPA 70-2018 [Section No. 690.12(C)]

(C) Initiation Device.

The initiation device(s) shall initiate the rapid shutdown function of the PV system. The device's "off" position shall indicate that the rapid shutdown function has been initiated for all PV systems connected to that device. For one-family and two-family dwellings or their detached garages, and associated storage buildings , an initiation device(s) shall be located at a readily accessible exterior location ~~outside the building.~~ on the building to which the PV array is attached.

The rapid shutdown initiation device(s) shall consist of at least one of the following:

(1) Service disconnecting means

(2) PV system disconnecting means

(3) Readily accessible switch that plainly indicates whether it is in the "off" or "on" position

Informational Note: One example of why an initiation device that complies with 690.12(C)(3) would be used is where a PV system is connected to an optional standby system that remains energized upon loss of utility voltage.

Where multiple PV systems are installed with rapid shutdown functions on a single service, the initiation device(s) shall consist of not more than six switches or six sets of circuit breakers, or a combination of not more than six switches and sets of circuit breakers, mounted in a single enclosure, or in a group of separate enclosures. These initiation device(s) shall initiate the rapid shutdown of all PV systems with rapid shutdown functions on that service. Where auxiliary initiation devices are installed, these auxiliary devices shall control all PV systems with rapid shutdown functions on that service.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 16:11:39 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This clarifies that enclosed outbuildings for one- and two-family dwellings with attached PV arrays include the requirements for 690.12 including the location of the initiation device on the building with a PV system.

Response Message:

Committee Notes:

Date	Submitted By	
Jan 15, 2018	NEC-CMP Panel 04	no change to informational note

Public Input No. 2258-NFPA 70-2017 [Section No. 690.12(C)]

Editorial Comment

Click here

First Revision No. 8251-NFPA 70-2018 [Section No. 690.12(D)]

(D) Equipment.

Equipment that performs the rapid shutdown functions, other than initiation devices such as listed disconnect switches, circuit breakers, or control switches, shall be listed for providing rapid shutdown protection.

~~Informational Note: Inverter input circuit conductors often remain energized for up to 5 minutes with inverters not listed for rapid shutdown.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 16:18:17 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The informational note is no longer needed.
Response Message:

Public Input No. 2782-NFPA 70-2017 [Section No. 690.12(D)]

First Revision No. 8264-NFPA 70-2018 [Section No. 690.13(A)]

(A) Location.

The PV system disconnecting means shall be installed at a readily accessible location. Where disconnecting means of systems above 30 V are readily accessible to unqualified persons, any enclosure door or hinged cover that exposes live parts when open shall be locked or require a tool to open.

Informational Note: PV systems installed in accordance with 690.12 address the concerns related to energized conductors entering a building.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 16:54:56 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision uses a similar format to 110.31(D) which addresses equipment accessible to unqualified persons. The installation of PV systems has created an opportunity for placement of disconnect switches in locations that are accessible by other than qualified personnel. The disconnect enclosures can often be easily opened exposing potentially life threating voltages and current levels if contacted by personnel. The disconnect equipment is being installed on accessible external and internal surfaces of dwellings, in garages, and in almost any room except bathrooms in dwellings. An opened disconnect enclosure contains wiring and terminals that can be touched with tools, probes or hands. There is a need to require, as a minimum, a tool to physically open these enclosures. The voltage level of 30V is consistent with other Article 690 requirements.

Response Message:

Public Input No. 3002-NFPA 70-2017 [Section No. 690.13(A)]

First Revision No. 8266-NFPA 70-2018 [Section No. 690.13(C)]

~~(C)~~ ~~Suitable for Use.~~

~~If the PV system is connected to the supply side of the service disconnecting means as permitted in 230.82(6) , the PV system disconnecting means shall be listed as suitable for use as service equipment.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 15 17:02:06 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This section is removed as it is addressed in 705.12(A) and is not needed in this location. Furthermore this language could be misconstrued to cause the reader to assume that conductors connected to these systems on the supply side of service disconnecting means are service conductors.

Response Message:

Public Input No. 1832-NFPA 70-2017 [Section No. 690.13(C)]

Public Input No. 1934-NFPA 70-2017 [Section No. 690.13(C)]

First Revision No. 8290-NFPA 70-2018 [Section No. 690.13(E)]

(D) Ratings.

The PV system disconnecting means shall have ratings sufficient for the maximum circuit current, available ~~short-circuit~~ fault current, and voltage that is available at the terminals of the PV system disconnect.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 08:04:58 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The sentence as written in the code specifies two different current values. The maximum circuit current is distinct from the available short-circuit current and a comma was added to separate the two. The term “short-circuit” is replaced with “fault” for consistency throughout the NEC.

Response Message:

Public Input No. 1833-NFPA 70-2017 [Section No. 690.13(E)]

Public Input No. 3003-NFPA 70-2017 [Section No. 690.13(E)]

Public Input No. 1284-NFPA 70-2017 [Section No. 690.13(E)]

First Revision No. 8295-NFPA 70-2018 [Section No. 690.13(F)]

(E) Type of Disconnect.

The PV system disconnecting means shall simultaneously disconnect the PV system conductors that are not solidly grounded from all conductors of other wiring systems. The PV system disconnecting means shall be one of the following:

(1) A manually operable switch or circuit breaker

(2) A connector meeting the requirements of 690.33(E)(1)

(3) A pull-out switch with the required interrupting rating

(4) A remote-controlled switch or circuit breaker that is operable locally and opens automatically when control power is interrupted

(5) A device listed or approved for the intended application

Informational Note: Circuit breakers marked “line” and “load” may not be suitable for backfeed or reverse current.

~~**(1)** Simultaneous Disconnection.~~

~~The PV system disconnecting means shall simultaneously disconnect the PV system conductors of the circuit from all conductors of other wiring systems. The PV system disconnecting means shall be an externally operable general-use switch or circuit breaker, or other approved means. A dc PV system disconnecting means shall be marked for use in PV systems or be suitable for backfeed operation.~~

~~**(1)** Devices Marked “Line” and “Load.”~~

~~Devices marked with “line” and “load” shall not be permitted for backfeed or reverse current.~~

~~**(1)** DC-Rated Enclosed Switches, Open-Type Switches, and Low-Voltage Power Circuit Breakers.~~

~~DC-rated, enclosed switches, open-type switches, and low-voltage power circuit breakers shall be permitted for backfeed operation.~~

Supplemental Information

File Name	Description	Approved
Panel_4_FR-8295_690.13_F_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 08:19:08 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The list under “Type of Disconnect” has been removed and the revision summarizes the type of disconnects that may be used as a PV system disconnect.

This revision clarifies that all non-solidly grounded conductors must be disconnected. However, ac neutral conductors, which are solidly grounded, are not required to be disconnected.

A connector that has an interrupt rating (690.33(E)(1)) is permitted provided that it simultaneously disconnects all system conductors. A pull-out switch with an interrupt rating is next which means it is a load-break rated switch. A remote-controlled switch or circuit breaker would allow shunt-trip breakers and other listed disconnects to be used as PV system disconnects. Lastly, a listed device that meets the requirements of a disconnect is permitted.

Sections 690.13(F)(2) and (3) are wrapped into the second paragraph that covers backfeed conditions. Rather than including a statement about line and load, an informational note speaks to the relevant issue that circuit breakers marked line and load have not necessarily been evaluated in the reverse direction.

Response Message:

Public Input No. 909-NFPA 70-2017 [Section No. 690.13(F)(1)]

Public Input No. 3005-NFPA 70-2017 [Section No. 690.13(F)(1)]

Public Input No. 3004-NFPA 70-2017 [Section No. 690.13(F)]

Public Input No. 3006-NFPA 70-2017 [Section No. 690.13(F)(2)]

Editorial Comment

Click here

First Revision No. 8307-NFPA 70-2018 [Section No. 690.15(A)]

(A) Location.

Isolating devices or equipment disconnecting means shall be installed in circuits connected to equipment at a location within the equipment, or within sight and within 3 m (10 ft) of the equipment. An equipment disconnecting means shall be permitted to be remote from the equipment where the equipment disconnecting means can be remotely operated from within 3 m (10 ft) of the equipment. Where disconnecting means of equipment operating above 30 volts are readily accessible to unqualified persons, any enclosure door or hinged cover that exposes live parts when open shall be locked or require a tool to open.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 08:58:16 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This FR addresses PI3008 and uses a similar format to 110.31(D) which addresses equipment accessible to unqualified persons. It also mirrors the language in 690.13(A). The installation of PV systems has created an opportunity for placement of disconnect switches in locations that are accessible by other than qualified personnel. The disconnect enclosures can often be easily opened exposing potentially life threating voltages and current levels if contacted by personnel. The disconnect equipment is being installed on accessible external and internal surfaces of dwellings, in garages, and in almost any room except bathrooms in dwellings. An opened disconnect enclosure contains wiring and terminals that can be touched with tools, probes or hands. There is a need to require, as a minimum, a tool to physically open these enclosures. The voltage level of 30V is consistent with other Article 690 requirements.

Response Message:

Public Input No. 3010-NFPA 70-2017 [Section No. 690.15(D)]

Public Input No. 3008-NFPA 70-2017 [Section No. 690.15(A)]

Editorial Comment

Click here

First Revision No. 8311-NFPA 70-2018 [Section No. 690.15(B)]

~~**(B)** Interrupting Rating.~~

~~An equipment disconnecting means shall have an interrupting rating sufficient for the maximum short-circuit current and voltage that is available at the terminals of the equipment. An isolating device shall not be required to have an interrupting rating.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 09:09:50 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This section is revised and moved to the respective sections on isolating devices or equipment disconnecting means. The concerns of both PIs are specifically addressed in the sentence moved to the equipment disconnecting means section.

Response Message:

Public Input No. 3009-NFPA 70-2017 [Section No. 690.15(B)]

Public Input No. 1285-NFPA 70-2017 [Section No. 690.15(B)]

First Revision No. 8321-NFPA 70-2018 [New Section after 690.15(C)]

(C) Circuits Connected to Electronic Power Converters.

Equipment disconnecting means in accordance with 690.15(D) shall be required to isolate dc circuits over 30 amperes connected to the input of electronic power converters. For dc circuits operating at 30 amperes or less connected to the input of electronic power converters, an isolating device in accordance with 690.15(B) shall be permitted.

Informational Note: Examples of circuits connected to the input of electronic power converters include, but are not limited to, the input circuits of dc-to-dc converters, electronic charge controllers, or inverters. If power electronics fail, these devices present a load to connected dc sources.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 09:32:23 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The deleted language from the first paragraph of 690.15 is captured in the new 690.15(C). The added sentence clarifies that isolating devices are permitted in certain cases.

The informational note provides details of types of equipment that was formerly spelled out in code text.

Response Message:

Editorial Comment

Click here

First Revision No. 8316-NFPA 70-2018 [Section No. 690.15(C)]

(B) Isolating Device.

An isolating device shall not be required to have an interrupting rating. Where an isolating device is not rated for interrupting the circuit current, it shall be marked "Do Not Disconnect Under Load" or "Not for Current Interrupting." An isolating device shall not be required to simultaneously disconnect all current-carrying conductors of a circuit. The isolating device shall be one of the following:

(1) A connector meeting the requirements of 690.33 and listed and identified for use with specific equipment

(2) A finger-safe fuse holder

(3) An isolating ~~switch~~ device that requires a tool to place in the open (off) position

(4) An isolating device listed for the intended application

~~An isolating device shall be rated to open the maximum circuit current under load or be marked "Do Not Disconnect Under Load" or "Not for Current Interrupting."~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 09:17:59 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision is related to the action taken in 690.15(A) related to tools and live parts. With the emphasis on tools to open enclosures, someone could misunderstand this item to be referring to the enclosure rather than the switch. This simple rewording clarifies that this is referring to opening the switch.

Information from former 690.15(B) is moved to the first sentence. The last sentence this section is moved to the second sentence.

Editorial Comment

Click here

First Revision No. 8327-NFPA 70-2018 [Section No. 690.15(D)]

(D) Equipment Disconnecting Means.

~~An equipment~~ Equipment disconnecting means shall have ratings sufficient for the maximum circuit current, available fault current, and voltage that is available at the terminals. Equipment disconnecting means shall simultaneously disconnect all current-carrying conductors that are not solidly grounded of the circuit to which it is connected. ~~An equipment~~ Equipment disconnecting means shall be externally operable without exposing the operator to contact with energized parts~~,~~ and shall indicate whether in the open (off) or closed (on) position. ~~and shall be lockable~~ Where not within sight and within 3 m (10 ft) of the equipment, the disconnecting means or its remote operating device or enclosure providing access to the disconnecting means shall be capable of being locked in accordance with 110.25. ~~An equipment~~ Equipment disconnecting means shall be ~~one of the following devices:~~ of the same type as required in 690.13(E).

(0) ~~A manually operable switch or circuit breaker~~

(0) ~~A connector meeting the requirements of 690.33(E)(1)~~

(0) ~~A load break fused pull out switch~~

(0) ~~A remote-controlled circuit breaker that is operable locally and opens automatically when control power is interrupted~~

~~For equipment~~ Equipment disconnecting means, other than those complying with 690.33, ~~where the~~ shall be marked in accordance with the warning in 690.13(B) if the line and load terminals can be energized in the open position~~, the device shall be marked in accordance with the warning in 690.13(B)~~ .

Informational Note: A common installation practice is to terminate PV source-side dc conductors in the same manner that utility source-side ac conductors are generally connected on the line side of a disconnecting means. This practice is more likely to de-energize load-side terminals, blades, and fuses when the disconnect is in the open position and no energized sources are connected to the load side of the disconnect.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 09:54:38 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The first sentence of 690.15(D) is added to address the language removed from 690.15(B) on interrupting ratings and added fault current. The lockability requirement is changed so that it is assigned only to the case where disconnecting means is more then 10' or not within site of the equipment. References to 690.13 have been added since the list of disconnect options is identical. Lastly, the final sentence is reorganized to read more clearly without changing the intent.

An informational note is added that it is common industry practice to terminate PV side conductors on the line side of the switch and utility side conductors on the line side as well.

Response Message:

Public Input No. 3011-NFPA 70-2017 [Section No. 690.15(D)]

Public Input No. 2250-NFPA 70-2017 [Section No. 690.15(D)]

Public Input No. 3012-NFPA 70-2017 [Section No. 690.15(D)]

Public Input No. 1584-NFPA 70-2017 [Section No. 690.15(D)]

Public Input No. 2259-NFPA 70-2017 [Section No. 690.15(D)]

Editorial Comment

Click here

First Revision No. 8305-NFPA 70-2018 [Section No. 690.15 [Excluding any Sub-Sections]]

Isolating devices shall be provided to ~~isolate~~ disconnect PV modules, ac PV modules, fuses, dc-to-dc converters, inverters, and charge controllers from all conductors that are not solidly grounded. ~~An equipment~~ Equipment disconnecting means ~~or a~~ and PV system disconnecting means ~~shall be permitted in place of an isolating device. Where the maximum circuit current is greater than 30 amperes for the output circuit of a dc combiner or the input circuit of a charge controller or inverter, an equipment disconnecting means shall be provided for isolation. Where a charge controller or inverter has multiple input circuits, a single equipment disconnecting means shall be permitted to isolate the equipment from the input circuits.~~ shall meet the requirements of isolating devices.

Informational Note: The purpose of these isolating devices ~~are for~~ is the safe and convenient replacement or service of specific PV system equipment without exposure to energized conductors.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 08:49:07 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Requirements related to circuits over 30 amperes are moved to a new section 690.15(C). The last sentence is unnecessary since one or more equipment disconnecting means can be used on the input or output of PV equipment.

Response Message:

Editorial Comment

Click here

First Revision No. 8645-NFPA 70-2018 [Section No. 690.31(A)]

(A) Wiring Systems.

All raceway and cable wiring methods included in this *Code*, other wiring systems and fittings specifically listed for use ~~on~~ in PV arrays, and wiring as part of a listed system shall be permitted. Where wiring devices with integral enclosures are used, sufficient length of cable shall be provided to facilitate replacement.

Where PV source and output circuits operating at voltages greater than 30 volts are installed in readily accessible locations, circuit conductors shall be guarded or installed in Type MC cable or in raceway. For ambient temperatures exceeding 30°C (86°F), conductor ampacities shall be corrected in accordance with Table 690.31(A)(a). The ampacity of 105°C (221°F) and 125°C (257°F) conductors shall be permitted to be determined by Table 690.31(A)(b).

Table 690.31(A)(a) Correction Factors

Ambient Temperature (°C)	Temperature Rating of Conductor				Ambient Temperature (°F)
	60°C (140°F)	75°C (167°F)	90°C (194°F)	105°C (221°F)	
30	1.00	1.00	1.00	1.00	86
31–35	0.91	0.94	0.96	0.97	87–95
36–40	0.82	0.88	0.91	0.93	96–104
41–45	0.71	0.82	0.87	0.89	105–113
46–50	0.58	0.75	0.82	0.86	114–122
51–55	0.41	0.67	0.76	0.82	123–131
56–60	—	0.58	0.71	0.77	132–140
61–70	—	0.33	0.58	0.68	141–158
71–80	—	—	0.41	0.58	159–176

-	Temperature Rating of Conductor		-
Ambient Temperature (°C)	105°C (221°F)	125°C (257°F)	Ambient Temperature (°F)
30	1	1	86
31–35	0.97	0.97	87–95
36–40	0.93	0.95	96–104
41–45	0.89	0.92	105–113
46–50	0.86	0.89	114–122
51–55	0.82	0.86	123–131
56–60	0.77	0.83	132–140
61–65	0.73	0.79	141–149
66–70	0.68	0.76	150–158
71–75	0.63	0.73	159–167
76–80	0.58	0.69	168–176
81–85	0.52	0.65	177–185
86–90	0.45	0.61	186–194
91–95	0.37	0.56	195–203
96–100	0.26	0.51	204–212
101–105	—	0.46	213–221
106–110	—	0.4	222–230
111–115	—	0.32	231–239
116–120	—	0.23	240–248

Table 690.31(A)(b) Ampacities of Insulated Conductors Rated Up To and Including 2000 Volts, 105°C Through 125°C (221°F Through 257°F), Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F)

AWG	Types

	PVC, CSPE, XLPE 105°C	XLPE, EPDM 125°C
18	15	16
16	19	20
14	29	31
12	36	39
10	46	50
8	64	69
6	81	87
4	109	118
3	129	139
2	143	154
1	168	181
1/0	193	208
2/0	229	247
3/0	263	284
4/0	301	325

Informational Note: See 110.14(C) for conductor temperature limitations due to termination provisions.

Supplemental Information

File Name	Description	Approved
FR-_8645_Table_690.31_A_2_.docx	New table 690.31(A)(2)--for staff use	✓
FR-8645_Table_690.31_A_1_.docx	New table 690.31(A)(1) - staff use only	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 07:58:28 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision cleans up Table 690.31(A)(1) [formerly Table 690.31(A)] by only including correction factors for 105C and 125C as all other factors are in Article 310. An ampacity table for 105C and 125C has been added as Table 690.31(A)(2). The temperature ranges above 60C are given in 5C increments.

Response Message:

Committee Notes:

Date	Submitted By	
Jan 25, 2018	NEC-CMP Panel 04	Should end up with 690.31(A) through (F) when done. This should be first section of 690.31.

Public Input No. 3494-NFPA 70-2017 [Section No. 690.31(A)]

Public Input No. 3022-NFPA 70-2017 [Section No. 690.31(H)]

Public Input No. 3723-NFPA 70-2017 [Section No. 690.31(A)]

Public Input No. 3036-NFPA 70-2017 [Section No. 690.31]

Editorial Comment

Click here

First Revision No. 8648-NFPA 70-2018 [Sections 690.31(B)(1), 690.31(B)(2)]

(1) Identification.

PV system circuit conductors shall be identified at all ~~accessible points of~~ termination, connection, and ~~splices. The means of identification shall be permitted by~~ splice points by ~~separate~~ color coding, marking tape, tagging, or other approved means. ~~Only solidly grounded PV system circuit conductors, in accordance with 690.41(A)(5) , shall be marked in accordance with 200.6~~ . Circuits relying on other than color coding for polarity identification shall be identified by an approved permanent marking means such as labeling, sleeving, or shrink-tubing that is suitable for the conductor size. The permanent marking means for nonsolidly grounded positive conductors shall include imprinted plus signs (+) or the word POSITIVE or POS durably marked on insulation of a color other than green, white, or gray. The permanent marking means for nonsolidly grounded negative conductors shall include imprinted negative signs (−) or the word NEGATIVE or NEG durably marked on insulation of a color other than green, white, gray, or red. Only solidly grounded PV system circuit conductors shall be marked in accordance with 200.6.

Exception: Where the identification of the conductors is evident by spacing or arrangement, further identification shall not be required.

(2) Grouping.

Where the conductors of more than one PV system occupy the same junction box or raceway with a removable cover(s), the ~~ac and dc~~ PV system conductors of each system shall be grouped separately by cable ties or similar means at least once and shall then be grouped at intervals not to exceed 1.8 m (6 ft).

Exception: The requirement for grouping shall not apply if the circuit enters from a cable or raceway unique to the circuit that makes the grouping obvious.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 08:47:32 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Section 630.31(B)(1) requires marking of dc conductors polarity. The language from Articles 210 and 215 on polarity markings is summarized in this section. Since positive and negative conductors can both be black due to sunlight resistance of cables, positive conductors are not prohibited from being black. Also, no size break at 6AWG is provided as with Articles 210 and 215 since positive conductors can be black and should be permitted to be marked with methods other than continuous color coding.

The current language in 690.31(B)(2) is revised slightly to remove the potentially inconsistent wording.

Response Message:

Public Input No. 3018-NFPA 70-2017 [Section No. 690.31(B)(1)]

Editorial Comment

Click here

First Revision No. 8647-NFPA 70-2018 [Section No. 690.31(B) [Excluding any Sub-Sections]]

PV ~~source~~ system dc circuits and ~~PV output circuits shall not be contained in the same raceway, cable tray, cable, outlet box, junction box, or similar fitting as conductors, feeders, branch circuits of~~ Class 1 control circuits of a PV system shall be permitted to occupy the same equipment wiring enclosure, cable, or raceway. PV system dc circuits shall not occupy the same equipment wiring enclosure, cable, or raceway. as other non-PV systems, or inverter output circuits, unless the ~~conductors of the different systems are separated~~ PV system dc circuits and Class 1 control circuits are separated from other circuits by a partition. PV system circuit conductors shall be identified and grouped as required by 690.31(B)(1) through (B) (2). ~~The means of identification shall be permitted by separate color coding, marking tape, tagging, or other approved means.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 08:21:42 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Section 690.31(B) has been clarified to address the most common application of this requirement for enforcers; installation of inverter dc input conductors and ac output conductors in the same wireway below an inverter. Dc and ac conductors of a PV system should not be allowed to come into contact with one another to prevent inadvertent injection of ac current onto a dc circuit during a fault. It is important to maintain physical separation between conductors as this type of fault may not be controlled by either dc or ac overcurrent protection. PV system conductors (dc & ac) should be kept separate from all other non-PV system conductors except at the point of interconnection. But the requirements for the inverter input (dc) and output (ac) conductors of the same system should be addressed separately. The current language in 690.31(B)(2) is revised slightly to remove the potentially inconsistent wording.

Response Message:

Committee Notes:

Date	Submitted By	
Jan 25, 2018	NEC-CMP Panel 04	Should end up with 690.31(A) through (F) when done.

Public Input No. 1261-NFPA 70-2017 [Section No. 690.31(B) [Excluding any Sub-Sections]]

Public Input No. 4146-NFPA 70-2017 [Section No. 690.31(B) [Excluding any Sub-Sections]]

Public Input No. 3017-NFPA 70-2017 [Section No. 690.31(B) [Excluding any Sub-Sections]]

Editorial Comment

Click here

First Revision No. 8650-NFPA 70-2018 [Section No. 690.31(C)]

(C) ~~Single-Conductor Cable~~ Cables .

(1) ~~General~~ Single-Conductor Cable .

~~**General**~~ Single-conductor PV wire or cable, and single-conductor Type USE-2 ~~and single-conductor cable listed and~~ identified as ~~photovoltaic (PV) wire~~ sunlight resistant shall be permitted in exposed outdoor locations in PV ~~source~~ system dc circuits within the PV array. Exposed cables shall be supported and secured at intervals not to exceed 600 mm (24 in.) by cable ties, straps, hangers, or similar fittings listed and identified for securement and support in outdoor locations. PV wire ~~shall be installed in accordance with 338.10(B)(4) (b) and 334.30~~ or cable is permitted in all locations where RHW-2 is permitted .

(2) Cable Tray.

~~**Cable Tray.**~~ PV ~~source circuits and PV output circuits using single-conductor cable listed and identified as photovoltaic (PV) wire of all sizes, with or without a cable tray marking/rating~~ system dc circuits using single-conductor PV wire or cable of all sizes, with or without a cable tray rating , shall be permitted in cable trays installed in outdoor locations, provided that the cables are supported at intervals not to exceed 300 mm (12 in.) and secured at intervals not to exceed 1.4 m (4½ ft).

Informational Note: ~~Photovoltaic~~ PV wire and ~~PV~~ cable have a nonstandard outer diameter. Table 1 of Chapter 9 contains the allowable percent of cross section of conduit and tubing for conductors and cables.

Detail FR-8940

(3) Multiconductor Cable.

~~Jacketed~~ Distributed generation (DG) cable and other jacketed multiconductor cable assemblies ~~listed and identified for the application~~ used in accordance with their listings shall be permitted in outdoor locations. The cable shall be secured at intervals not exceeding 1.8 m (6 ft).

(4) Flexible Cords and Cables Connected to Tracking PV Arrays.

Flexible cords and flexible cables, where connected to moving parts of tracking PV arrays, shall comply with Article 400 and shall be of a type identified as a hard service cord or portable power cable; they shall be suitable for extra-hard usage, listed for outdoor use, water resistant, and sunlight resistant. Allowable ampacities shall be in accordance with 400.5. Stranded copper PV wire shall be permitted to be connected to moving parts of tracking PV arrays in accordance with the minimum number of strands specified in Table 690.31(C)(4).

Table 690.31(C)(4) Minimum PV Wire Strands

PV Wire AWG	Minimum Strands
18	17
16–10	19
8–4	49
2	130
1 AWG–1000 MCM	259

(5) Flexible, Fine-Stranded Cables.

Flexible, fine-stranded cables shall be terminated only with terminals, lugs, devices, or connectors in accordance with 110.14.

(6) Small-Conductor Cables.

Single-conductor cables listed for outdoor use that are sunlight resistant and moisture resistant in sizes 16 AWG and 18 AWG shall be permitted for module interconnections where such cables meet the ampacity requirements of 400.5. Section 310.14 shall be used to determine the cable ampacity adjustment and correction factors.

Supplemental Information

File Name	Description	Approved
Panel_4_FR-8650_690.31_C_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 08:52:12 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision is a clean-up of 690.31 as it remains the most lengthy portion of Article 690. Several of the items in 690.31 are directly related to cables. Those requirements are consolidated in the new section 690.31(C).

Section 690.31(C)(1) restricts the use of USE-2 in PV systems to cables also marked “sunlight resistant”. These cables are often also listed RHW-2 or XHHW-2. Nearly all USE-2 cable used in PV systems over the past 15 years is also rated sunlight resistant and either RHW-2 or XHHW-2. The second to last sentence is changed to provide a specific prescriptive requirement for support and securement of these cables rather than a reference. Previous requirements caused conflicts with listed PV modules and racking systems. In many cases there is no location at which to secure these conductors within 12 inches of the module junction box (as required in 334.30)—whether or not this is actually a “junction box” is irrelevant as it is commonly referred to as such by many AHJs, inspectors, manufacturers, and installers. Additionally, the 4.5-foot requirement in 334.30 results in too long of a distance between points of securing and supporting, allowing conductors the potential to droop and contact grounded metal rack parts or roof surfaces. Wire positioning devices are covered by UL1565. The last sentence is added to make it clear that PV wire can be used inside buildings since the cable must pass all the requirements of RHW-2.

With the revisions to 690.31(C)(1), similar edits are made to (C)(2) and the informational note for clarity and consistency.

Response Message:

Committee Notes:

Date	Submitted By	
Jan 18, 2018	NEC-CMP Panel 04	this section shows correctly when in edit mode. not sure why it shows what it does when looked at inline.
Jan 25, 2018	NEC-CMP Panel 04	Should end up with 690.31(A) through (F) when done.

Public Input No. 3938-NFPA 70-2017 [Section No. 690.31(C)]

Public Input No. 3019-NFPA 70-2017 [Section No. 690.31(C)]

Public Input No. 3799-NFPA 70-2017 [Section No. 690.31(C)]

Public Input No. 1122-NFPA 70-2017 [Section No. 690.31(C)]

First Revision No. 8692-NFPA 70-2018 [Section No. 690.31(G)]

(D) ~~Photovoltaic System~~ Direct-Current Circuits on or in a Building.

~~Where~~ PV system dc circuits ~~run inside a building, they~~ inside buildings greater than 30 volts and 70 watts shall be contained in metal raceways, in Type MC metal-clad cable that complies with 250.118(10), or in metal enclosures ~~from the point of penetration of the surface of the building to the first readily accessible disconnecting means. The disconnecting means shall comply with 690.13(B) and (C) and 690.15(A) and (B). The wiring methods~~ . Wiring methods on or in a building shall comply with the additional installation requirements in 690.31(G)(1) through (4).

Exception: PV hazard control systems installed in accordance with 690.12(B)(2)(1) shall be provided with or listed for use with nonmetallic enclosure(s), nonmetallic raceway(s), and cables of a permitted type other than Type MC metal-clad cable(s), at the point of penetration of the surface of the building to the PV hazard control actuator.

~~**(1)** Embedded in Building Surfaces.~~

~~Where circuits are embedded in built-up, laminate, or membrane roofing materials in roof areas not covered by PV modules and associated equipment, the location of circuits shall be clearly marked using a marking protocol that is approved as being suitable for continuous exposure to sunlight and weather.~~

(1) Flexible Wiring Methods.

Where flexible metal conduit (FMC) smaller than metric designator 21 (trade size ¾) or Type MC cable smaller than 25 mm (1 in.) in diameter containing PV power circuit conductors is installed across ceilings or floor joists, the raceway or cable shall be protected by substantial guard strips that are at least as high as the raceway or cable. Where run exposed, other than within 1.8 m (6 ft) of their connection to equipment, these wiring methods shall closely follow the building surface or be protected from physical damage by an approved means.

(2) Marking and Labeling Required.

~~The~~ Unless located and arranged so the purpose is evident, the following wiring methods and enclosures that contain PV system dc circuit conductors shall be marked with the wording ~~WARNING:~~ PHOTOVOLTAIC POWER SOURCE or SOLAR PV DC CIRCUIT by means of permanently affixed labels or other approved permanent marking:

(1) Exposed raceways, cable trays, and other wiring methods

(2) Covers or enclosures of pull boxes and junction boxes

(3) Conduit bodies in which any of the available conduit openings are unused

The labels or markings shall be visible after installation. ~~The labels shall be reflective, and all~~ All letters shall be capitalized and shall be a minimum height of 9.5 mm (⅜ in.) in white on a red background. ~~PV system dc circuit labels~~ Labels shall appear on every section of the wiring system that is separated by enclosures, walls, partitions, ceilings, or floors. Spacing between labels or markings, or between a label and a marking, shall not be more than 3 m (10 ft). Labels required by this section shall be suitable for the environment where they are installed.

~~**(3)** Marking and Labeling Methods and Locations.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:

Submittal Date: Thu Jan 18 12:07:01 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Section 690.31(D) is related to FR-8398 that removes ground-fault protection requirements for circuits under 30 volt and 70W. The title of this section is shortened to be more descriptive of what it covers. The text explicitly states that it refers to PV system dc circuits greater than 30 volts and 70W.

The purpose of this change is to acknowledge that the physical protection requirements of 690.31(D) are related to the ability to detect ground faults and to protect from contact with higher voltage cables. For circuits that are low voltage and low energy, there is little benefit to containing these circuits in metal raceways. These low voltage and power circuits were not envisioned when this requirement went into the NEC. As a result of designs being considered for compliance with 690.12, these low voltage and power circuits are now feasible design options.

Also, the stipulations about from the point of penetration to the first readily accessible disconnecting means is a holdover from before 690.12 was introduced to the NEC. There is no reason to limit this requirement to before a dc disconnect. It should apply equally to higher voltage and power circuits before and after dc disconnects.

The new exception addresses PV hazard control systems. Some PV hazard control systems rely upon PV array isolation from ground to reduce shock hazards for fire fighters. High heat resulting from a roof fire and other abnormal conditions can potentially break down conductor insulation for PV circuits installed in metallic raceways and enclosures, creating a potential ground fault. Such a ground fault can ground reference otherwise isolated PV array conductor(s) potentially reducing the effectiveness of PV hazard control systems.

The section on embedded building surfaces was removed as the marking requirement refers to a wiring method that is no longer used.

This revision adds language to clarify that wiring methods need not be marked where their purpose is evident.

Warning labels on conduit and conduit bodies were not originally for first responders. The marking requirements to indicate the presence of a PV source for wiring methods, boxes and enclosures which could be accessed by service personnel. Additionally, the identification aid first responders to identify a PV system if they have not already been alerted to the presence of the system. The red color of the sign [690.31(G)(4)] provides indication of danger; removing the term “WARNING” brings the labeling in alignment with existing safety color standards referenced in 110.21(B). The PHOTOVOLTAIC POWER SOURCE sign is provided with an alternative wording of SOLAR PV DC CIRCUIT.

Response Message:

Committee Notes:

Date	Submitted By	
Jan 25, 2018	NEC-CMP Panel 04	Should end up with 690.31(A) through (F) when done.

Public Input No. 307-NFPA 70-2017 [Section No. 690.31(G)(4)]

Public Input No. 4086-NFPA 70-2017 [Section No. 690.31(G) [Excluding any Sub-Sections]]

Public Input No. 302-NFPA 70-2017 [Section No. 690.31(G)(3)]

Public Input No. 3033-NFPA 70-2017 [Section No. 690.31(G)]

Public Input No. 306-NFPA 70-2017 [Section No. 690.31(G)(3)]

Public Input No. 3021-NFPA 70-2017 [Section No. 690.31(G)(3)]

Public Input No. 4164-NFPA 70-2017 [Section No. 690.31(G)(3)]

Editorial Comment

Click here

First Revision No. 8693-NFPA 70-2018 [Section No. 690.31(H)]

~~**(H)** Flexible, Fine-Stranded Cables.~~

~~Flexible, fine-stranded cables shall be terminated only with terminals, lugs, devices, or connectors in accordance with 110.14 .~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 12:20:46 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Former 690.31(H) has been moved into new Item (5) of new 690.31(C).
Response Message:

First Revision No. 8695-NFPA 70-2018 [New Section after 690.31(I)]

(F) Wiring Methods and Mounting Systems.

Roof-mounted PV array mounting systems shall be permitted to be held in place with an approved means other than those required by 110.13 and shall utilize wiring methods that allow any expected movement of the array.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 12:31:53 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The requirements for mounting ballasted PV system are found in the building code and associated industry standards for the building code. The building code may allow for some movement of a PV array. If a ballasted PV system is not constrained to prevent movement during a seismic event, there are calculations for how far a ballasted system is expected to move. For wiring methods connected to a ballasted array, there needs to be flexibility built into the wiring method to prevent separation and damage for expected movement during a seismic event. Alternatively, the wiring method's termination points can be anchored to the structure so that regardless of movement within the PV array the wiring method remains in place. The California Electrical Code has an exception related to fixing equipment in place for ballasted systems found in its Section 110.13 and the more appropriate place for this requirement is in 690.31.

Response Message:

Committee Notes:

Date	Submitted By	
Jan 25, 2018	NEC-CMP Panel 04	Should end up with 690.31(A) through (F) when done. This should be the last section of 690.31.

Public Input No. 4198-NFPA 70-2017 [New Section after 690.31(I)]

First Revision No. 8694-NFPA 70-2018 [Section No. 690.31(I)]

(E) Bipolar Photovoltaic Systems.

Where the sum, without consideration of polarity, of the voltages of the two monopole ~~subarrays~~ subarray circuits exceeds the rating of the conductors and connected equipment, monopole ~~subarrays~~ subarray circuits in a bipolar PV system shall be physically separated, and the electrical output circuits from each monopole subarray circuit shall be installed in separate raceways until connected to the inverter. The disconnecting means and overcurrent protective devices for each monopole subarray circuit output shall be in separate enclosures. All conductors from each separate monopole subarray circuit shall be routed in the same raceway. Solidly grounded bipolar PV systems shall be clearly marked with a permanent, legible warning notice indicating that the disconnection of the grounded conductor(s) may result in overvoltage on the equipment.

Exception: Listed switchgear rated for the maximum voltage between circuits and containing a physical barrier separating the disconnecting means for each monopole subarray shall be permitted to be used instead of disconnecting means in separate enclosures.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 12:24:38 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision addresses consistency in the use of the term monopole subarray. Each time the term is used in 690.31(E), it is referring to circuits so the term “circuit” was added in all five locations where monopole subarray is used.

Committee Notes:

Date	Submitted By	
Jan 25, 2018	NEC-CMP Panel 04	Should end up with 690.31(A) through (F) when done.

Editorial Comment

Click here

First Revision No. 8393-NFPA 70-2018 [Section No. 690.32]

690.32 Component Interconnections.

Fittings and connectors that are intended to be concealed at the time of on-site assembly, where listed for such use, shall be permitted for on-site interconnection of modules or other array components. Such fittings and connectors shall be equal to the wiring method employed in insulation, temperature rise, and ~~fault-current withstand~~ short-circuit current rating , and shall be capable of resisting the effects of the environment in which they are used.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 15:01:48 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This change improves the applicability of the Code to better align with terms used in the ratings of the appropriate equipment and component listing standards.
Response Message:

Public Input No. 1286-NFPA 70-2017 [Section No. 690.32]

First Revision No. 8395-NFPA 70-2018 [Sections 690.33(D), 690.33(E)]

~~**(D)** Grounding Member.~~

~~The grounding member shall be the first to make and the last to break contact with the mating connector.~~

(D) Interruption of Circuit.

Connectors shall be ~~either (1) or (2)~~ one of the following :

(1) ~~Be rated~~ Rated for interrupting current without hazard to the operator.

(2) ~~Be a~~ A type that requires the use of a tool to open and marked “Do Not Disconnect Under Load” or “Not for Current Interrupting.”

(3) Supplied as part of listed equipment and used in accordance with instructions provided with the listed connected equipment.

Informational Note: Some listed equipment, such as micro inverters, are evaluated to make use of connectors as disconnect devices even though the connectors are marked as “Do Not Disconnect Under Load” or “Not for Current Interrupting.”

Supplemental Information

File Name	Description	Approved
Panel_4_FR-8395_690.33_D_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 15:05:48 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Former Subsection (D) has been removed since these requirements are adequately addressed in product safety standards applicable to connectors used in PV systems (i.e. UL486 and UL6703). A new option (3) has been added to allow for other connectors that are included in the listing of equipment. An informational note has been added to clarify a typical application of this new subsection.

Response Message:

Committee Notes:

Date	Submitted By	
Jan 17, 2018	NEC-CMP Panel 04	no change to item (1) or (2) in original (E).

Public Input No. 4028-NFPA 70-2017 [Section No. 690.33]

Public Input No. 4112-NFPA 70-2017 [Section No. 690.33(E)]

Public Input No. 4123-NFPA 70-2017 [Section No. 690.33(E)]

Editorial Comment

Click here

First Revision No. 8481-NFPA 70-2018 [Section No. 690.41(A)]

(A) PV System Grounding Configurations.

One or more of the following system grounding configurations shall be employed:

(1) 2-wire PV arrays with one ~~functional~~ functionally grounded conductor

(2) Bipolar PV arrays according to 690.7(C) with a functional ground reference (center tap)

(3) PV arrays not isolated from the grounded inverter output circuit

(4) Ungrounded PV arrays

(5) Solidly grounded PV arrays as permitted in 690.41(B) Exception

(6) PV systems that use other methods that accomplish equivalent system protection in accordance with 250.4(A) with equipment listed and identified for the use

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 07:54:22 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The revision better aligns with the definitions in 690.2 and with common grammatical rules.

Response Message:

Public Input No. 3013-NFPA 70-2017 [Section No. 690.41(A)]

First Revision No. 8401-NFPA 70-2018 [Section No. 690.41(B)(1)]

(1) Ground-Fault Detection.

The ground-fault ~~protective~~ protection device or system shall detect ground fault(s) in the PV ~~array~~ system dc ~~current-carrying~~ circuit conductors ~~and components~~ , including any functional grounded conductors, and be listed for providing PV ground-fault protection. For dc-to-dc converters not listed as providing ground-fault protection, where required, listed ground fault protection equipment identified for the combination of the dc-to-dc converter and ground-fault protection device shall be installed to protect the circuit.

Informational Note: Some dc-to-dc converters without integral ground-fault protection on their input (source) side can prevent other ground-fault protection equipment from properly functioning on portions of PV system dc circuits.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 15:29:36 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Revisions to this section referring to functionally grounded systems are made to better align with the definitions in 690.2 and with common grammatical rules.

New language has been added to address the potential that the addition of some dc-to-dc converters onto PV circuits could defeat or otherwise negatively impact ground-fault protection of the circuit. The new language clarifies that either ground fault protection must be included in the converter, or the converter and the equipment providing ground fault protection must be identified as being compatible such that ground fault protection of the circuit is maintained on either side of the converter.

Response Message:

Public Input No. 3944-NFPA 70-2017 [Section No. 690.41(B)(1)]

Editorial Comment

Click here

First Revision No. 8402-NFPA 70-2018 [Section No. 690.41(B)(2)]

(2) ~~Isolating~~ Faulted Circuits.

The faulted circuits shall be ~~isolated~~ controlled by one of the following methods:

(1) The current-carrying conductors of the faulted circuit shall be automatically disconnected.

(2) The ~~inverter or charge controller~~ device providing ground-fault protection fed by the faulted circuit shall automatically cease to supply power to output circuits and ~~isolate~~ interrupt the faulted PV system dc circuits from the ground reference in a ~~functional~~ functionally grounded system.

(3) Indication of Faults.

Equipment performing ground-fault protection mounted in not readily accessible locations shall have means to provide remote indication of ground faults.

Informational Note: Examples of remote indication may be provided by means such as, but not limited to, the following: remote indicator light, display, monitor, signal to a monitored alarm system, or receipt of notification by web-based services.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 15:43:31 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The revised text improves the application of these requirements to any device providing ground fault protection and clarifies the circuits to be controlled. Changes also better align the NEC requirements with those found in PV ground-fault protection equipment safety standards.

UL 1741 requires inverters to identify, interrupt, and provide an indication of ground faults, yet the NEC has not required the installation to ensure indication is visible where no other method is provided, in the event of a fault. Where inverters are located in areas such as under an array, or on a roof or wall where a provided notification signal cannot be seen from a standing position, an option should be provided to ensure indication and or notification is provided via a remote method.

Response Message:

Public Input No. 4005-NFPA 70-2017 [Section No. 690.41(B)(2)]

Editorial Comment

Click here

First Revision No. 8398-NFPA 70-2018 [Section No. 690.41(B) [Excluding any Sub-Sections]]

~~DC PV arrays~~ PV system dc circuits greater than 30 volts and 70 watts shall be provided with dc ground-fault protection meeting the requirements of 690.41(B)(1) and (B) (2) to reduce fire hazards.

~~*Exception: PV arrays with not more than two PV source circuits and with all PV system dc circuits not on or in buildings shall be permitted without ground-fault protection where solidly grounded.*~~

Solidly grounded PV arrays with not more than two PV source circuits and with all PV system dc circuits not on or in buildings shall be permitted without ground-fault protection ~~where solidly grounded~~ .

Informational Note: Not all inverters, charge controllers, or dc-to-dc converters include ground-fault protection. Equipment that does not have ground-fault protection may have the following statement in the manual: “Warning: This unit is not provided with a GFDI device.”

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 15:09:35 EST 2018

Committee Statement and Meeting Notes

Committee Statement: PV system circuits operating at these low voltage and power levels do not pose an arcing or other fire risk, therefore they are permitted to be installed without ground-fault protection. Updated development activities for PV dc AFCI and GFP requirements in both UL 1699-B and UL 62109-2 acknowledge that only energy values above these levels has been shown to potentially ignite common materials likely to be in contact with PV system equipment on buildings.

The exception has been reworded into positive language suitable for inclusion into the charging paragraph without changing the existing requirements.

Revisions to this section referring to functionally grounded systems are made to better align with the definitions in 690.2 and with common grammatical rules.

Response Message:

Public Input No. 4003-NFPA 70-2017 [Section No. 690.41(B) [Excluding any Sub-Sections]]

Public Input No. 3034-NFPA 70-2017 [Sections 690.41(B)(1), 690.41(B)(2)]

Public Input No. 3016-NFPA 70-2017 [Section No. 690.41(B)]

Editorial Comment

Click here

First Revision No. 8408-NFPA 70-2018 [Section No. 690.43]

690.43 Equipment Grounding and Bonding.

Exposed non–current-carrying metal parts of PV module frames, electrical equipment, and conductor enclosures of PV systems shall be ~~grounded~~ connected to an equipment grounding conductor in accordance with 250.134 or 250.136(A), regardless of voltage. Equipment grounding conductors and devices shall comply with 690.43(A) through ~~(C)~~ (E) .

(A) Photovoltaic Module Mounting Systems and Devices.

Devices and systems used for mounting PV modules that are also used for bonding module frames shall be listed, labeled, and identified for bonding PV modules. Devices that mount adjacent PV modules shall be permitted to bond adjacent PV modules.

(B) Equipment Secured to Grounded Metal Supports.

Devices listed, labeled, and identified for bonding and grounding the metal parts of PV systems shall be permitted to bond the equipment to grounded metal supports. Metallic support structures shall have identified bonding jumpers connected between separate metallic sections or shall be identified for equipment bonding and shall be connected to the equipment grounding conductor.

(C) With Circuit Conductors.

Equipment grounding conductors for the PV array and support structure ~~(~~ where installed~~)~~ , shall be contained within the same raceway~~,~~ or cable, or otherwise run with the PV ~~array circuit~~ system conductors ~~when~~ where those circuit conductors leave the vicinity of the PV array.

(D) Bonding for Over 250 Volts.

The bonding requirements contained in 250.97 shall apply only to solidly grounded PV system circuits operating over 250 volts to ground.

(E) Conductor Installation.

Equipment grounding and bonding conductors shall comply with 250.120.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 15:53:41 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The replacement of the general term “grounded” clarifies the requirement.

The change in (C) from “array circuit” to “system” conductors clarifies that this requirement applies to all conductors in a PV system. A change from “when” to “where” is made to better identify that this is a location based requirement.

PV sources are current limited and will have limited fault-currents to grounded parts due to required ground-fault protection or energy limits. Only some solidly grounded PV systems can be installed without ground fault protection. The additional bonding requirements in 250.97 do not provide any practical improvement in safety for functionally grounded PV systems regardless of voltage.

This revised text in (E) combines the previous requirements in 690.46 and 690.50 into a simplified statement more suitable for all PV applications.

Response Message:

Public Input No. 3020-NFPA 70-2017 [Section No. 690.43]

Public Input No. 3024-NFPA 70-2017 [Section No. 690.43(C)]

Public Input No. 1836-NFPA 70-2017 [Section No. 690.43 [Excluding any Sub-Sections]]

Editorial Comment

Click here

First Revision No. 8413-NFPA 70-2018 [Section No. 690.45]

690.45 Size of Equipment Grounding Conductors.

(A) PV System AC and DC Circuits.

Equipment grounding conductors ~~for PV source and PV output circuits~~ shall be sized in accordance with 250.122. Where no overcurrent protective device is used in the circuit, an assumed overcurrent device rated in accordance with 690.9(B)shall be used when applying Table 250.122.

(B) PV System DC Circuits.

Increases in equipment grounding conductor size to address voltage drop considerations shall not be required. ~~An equipment grounding conductor shall not be smaller than 14 AWG.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 16:01:50 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The section has been reorganized to improve the applicability of this section. The phrase "PV source and PV output circuits" has been replaced with the new subsection header to clarify that these requirements apply to all circuits in a PV system. The addition of "PV system dc circuits" to the new header in (B) restricts this allowance to only dc circuits within the PV system. The last sentence is removed as it is not needed since the smallest conductor in Table 250.122 is 14 AWG.

Response Message:

Public Input No. 3026-NFPA 70-2017 [Section No. 690.45]

First Revision No. 8417-NFPA 70-2018 [Section No. 690.47(A)]

(A) Buildings or Structures Supporting a PV ~~Array~~ System .

A building or structure(s) supporting a PV ~~array~~ system shall ~~have~~ utilize a grounding electrode system installed in accordance with Part III of Article 250.

PV array equipment grounding conductors shall be connected to ~~the~~ a grounding electrode system ~~of the building or structure supporting the PV array~~ in accordance with Part VII of Article 250. This connection shall be in addition to any other equipment grounding conductor requirements in 690.43(C). The PV array equipment grounding conductors shall be sized in accordance with 690.45. For specific PV system grounding configurations permitted in 690.41(A), one of the following conditions shall apply:

(1) For PV systems that are not solidly grounded, the equipment grounding conductor for the output of the PV system, where connected to associated distribution equipment connected to a grounding electrode system , shall be permitted to be the only connection to ground for ~~ground-fault protection and equipment grounding of the PV array~~ the system .

(2) For solidly grounded PV systems, as permitted in 690.41(A)(5), the grounded conductor shall be connected to a grounding electrode system by means of a grounding electrode conductor sized in accordance with 250.166.

Informational Note: Most PV systems ~~installed in the past decade~~ are ~~actually functional~~ functionally grounded systems rather than solidly grounded systems as defined in this *Code*. For ~~functional~~ functionally grounded PV systems with an interactive inverter output, the ac equipment grounding conductor is connected to associated grounded ac distribution equipment. This connection is most often the connection to ground for ground-fault protection and equipment grounding of the PV array.

Supplemental Information

File Name	Description	Approved
Panel_4_FR-8417_690.47_A_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 16:09:31 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The first revision improves the usability of the Code and clarifies the existing requirements. New list numbers were added for ease of use. Specific changes were made to clarify that the grounding electrode system utilized by the PV system can be shared by other systems.

Response Message:

Public Input No. 1853-NFPA 70-2017 [Section No. 690.47(A)]

Public Input No. 4011-NFPA 70-2017 [Section No. 690.47(A)]

Public Input No. 3031-NFPA 70-2017 [Section No. 690.47]

Editorial Comment

Click here

First Revision No. 8419-NFPA 70-2018 [Section No. 690.47(B)]

(B) ~~Additional Auxiliary Electrodes for Array Grounding.~~ Grounding Electrodes and Grounding Electrode Conductors.

~~Grounding~~ Additional grounding electrodes shall be permitted to be installed in accordance with 250.52 and 250.54~~at the location of ground- and roof-mounted PV arrays. The~~ . Grounding electrodes shall be permitted to be connected directly to the ~~array~~ PV module frame(s) or support structure. ~~The~~ A grounding electrode conductor shall be sized according to 250.66. ~~The~~ A support structure ~~of~~ for a ground-mounted PV array shall be permitted to be considered a grounding electrode if it meets the requirements of 250.52. ~~Roof mounted~~ PV arrays mounted to buildings shall be permitted to use the metal structural frame of ~~a~~ the building ~~or structure~~ if the requirements of ~~250.52(A)(2)~~ 250.68(C)(2) are met.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 16:18:17 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Changes to this section improve the usability of the Code and clarify the existing requirements and allowances. A section title change has been made to allow the conditions in this section to apply to systems with or without auxiliary grounding electrodes. Several references to other Code sections are kept in this section to assist with the application of Article 250 to grounding electrodes and grounding electrode conductors in some specific, but not all, types of PV applications. The reference to 250.52(A)(2) has been changed to 250.68(C)(2) to reflect the relocation of relevant information made during the last cycle.

Response Message:

Public Input No. 1935-NFPA 70-2017 [Section No. 690.47(B)]

Public Input No. 1854-NFPA 70-2017 [Section No. 690.47(B)]

Public Input No. 914-NFPA 70-2017 [Section No. 690.47(B)]

First Revision No. 8422-NFPA 70-2018 [Section No. 690.50]

~~**690.50** Equipment Bonding Jumpers.~~

~~Equipment bonding jumpers, if used, shall comply with 250.120(C) .~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 16:20:06 EST 2018

Committee Statement and Meeting Notes

Committee Statement: These requirements have been incorporated into a new 690.43(E) subsection.
Response Message:

Public Input No. 1855-NFPA 70-2017 [Section No. 690.50]

Public Input No. 3032-NFPA 70-2017 [Section No. 690.50]

First Revision No. 8707-NFPA 70-2018 [Section No. 690.51]

690.51 Modules and AC Modules .

Modules and ac modules shall be marked in accordance with their listing. ~~identification of terminals or leads as to polarity, maximum overcurrent device rating for module protection, and with the following ratings:~~

(0) ~~Open-circuit voltage~~

(0) ~~Operating voltage~~

(0) ~~Maximum permissible system voltage~~

(0) ~~Operating current~~

(0) ~~Short-circuit current~~

(0) ~~Maximum power~~

Supplemental Information

File Name	Description	Approved
Panel_4_FR-8707_690.51_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 13:39:25 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The information outlined in 690.51 is required as part of the listing requirement of this equipment. Since this equipment is required to be listed per 690.4(B), there is no option to install a PV module without this information being provided on the device by the manufacturer. A reference to ac modules has been included to incorporate the requirements previously contained in 690.52.

Response Message:

Public Input No. 876-NFPA 70-2017 [Section No. 690.51]

Public Input No. 3538-NFPA 70-2017 [Section No. 690.51]

Editorial Comment

Click here

First Revision No. 8709-NFPA 70-2018 [Section No. 690.52]

~~**690.52** Alternating-Current Photovoltaic Modules.~~

~~Alternating-current modules shall be marked with identification of terminals or leads and with identification of the following ratings:~~

(0) ~~Nominal operating ac voltage~~

(0) ~~Nominal operating ac frequency~~

(0) ~~Maximum ac power~~

(0) ~~Maximum ac current~~

(0) ~~Maximum overcurrent device rating for ac module protection~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 13:41:42 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The information outlined in 690.52 is required as part of the listing requirement of this equipment. Since this equipment is required to be listed per 690.4(B), there is no option to install a PV ac module without this information being provided on the device by the manufacturer. A reference to ac modules being marked in accordance with their listing has been added to 690.51.

Response Message:

Public Input No. 3539-NFPA 70-2017 [Section No. 690.52]

Public Input No. 877-NFPA 70-2017 [Section No. 690.52]

First Revision No. 8711-NFPA 70-2018 [Section No. 690.53]

690.53 ~~Direct-Current Photovoltaic Power Source~~ DC PV Circuits .

A permanent readily visible label ~~for the dc PV power source indicating the information specified in (1) through (3) shall be provided by the installer at dc PV system disconnecting means and at each dc equipment disconnecting means required by~~ 690.15 ~~. Where a disconnecting means has more than one dc PV power source, the values in~~ 690.53(1) ~~through (3) shall be specified for each source.~~ indicating the highest maximum dc voltage in a PV system, calculated in accordance with 690.7 , shall be provided by the installer at one of the following locations:

(1) ~~Maximum voltage~~ DC PV system disconnecting means

~~Informational Note to (1): See 690.7 for voltage.~~

(2) ~~Maximum circuit current~~ PV system electronic power conversion equipment

~~Informational Note to (2): See 690.8(A) for calculation of maximum circuit current.~~

(3) ~~Maximum rated output current of the charge controller or dc-to-dc converter (if installed)~~ Distribution equipment associated with the PV system

Supplemental Information

File Name	Description	Approved
Panel_4_FR-8711_690.53_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 13:43:35 EST 2018

Committee Statement and Meeting Notes

Committee Statement: All major PV system equipment is required to be listed, typically for PV applications. Many labels previously required in Article 690 have been incorporated into the product safety standards. Requirements for the labeling of the installed dc power source circuit is important within this section since these values may vary significantly between different system designs. In an effort to improve the effectiveness of labeling this revision limits the quantity of labels, and the degree of information contained in them, to only those that are most important to persons maintaining and operating the PV system.

A single field-applied label indicating the maximum dc voltage must be installed for any PV system with dc circuits. This is required for safety purposes to clearly indicate the maximum voltage to servicing personal for PPE and tool selection. Since some PV equipment, such as certain inverters, may have multiple dc circuit inputs, the highest value present in the system is used on the single label.

Values for maximum circuit current have been removed from the label requirements since all equipment will be marked with its rated current through its listing. It is also desirable to remove these values from the required label in order to not inadvertently create conflict or confusion with any other required safety labeling such as may be required in Article 110.

The information previously outlined in 690.53(3)(3) is required as part of the listing requirement of this equipment. Since this equipment is required to be listed per 690.4(B), there is no option to install this equipment without this information being provided on the device by the manufacturer.

The purpose of the informational note has been captured in the new text so this informational note has been deleted.

Response Message:

Public Input No. 3532-NFPA 70-2017 [Section No. 690.53]

Editorial Comment

Click here

First Revision No. 8423-NFPA 70-2018 [Section No. 690.56(A)]

(A) Facilities with Stand-Alone Systems.

~~Any structure or building with a PV power system that is not connected to a utility service source and is a stand-alone system shall have a permanent plaque or directory installed on the exterior of the building or structure at a readily visible location. The plaque or directory shall indicate the location of system disconnecting means and that the structure contains a stand-alone electrical power system.~~ Plaques or directories shall be installed in accordance with 710.10.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 16:26:12 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Language has been added to recognize the use of plaques and directories in standalone systems.

Response Message:

Public Input No. 3713-NFPA 70-2017 [Section No. 690.56(A)]

Public Input No. 3039-NFPA 70-2017 [Section No. 690.56(A)]

First Revision No. 8425-NFPA 70-2018 [Section No. 690.56(B)]

(B) Facilities with Utility Services and Photovoltaic Systems.

Plaques or directories shall be installed in accordance with 705.10 and 712.10, as required .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 16:31:09 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Language has been added to recognize the use of plaques and directories in interconnected dc systems such as dc microgrids.

Response Message:

Public Input No. 3717-NFPA 70-2017 [Section No. 690.56(B)]

Editorial Comment

Click here

First Revision No. 8715-NFPA 70-2018 [Section No. 690.56(C)]

(C) Buildings with Rapid Shutdown.

Buildings with PV systems shall have a permanent labels ~~as described in 690.56(C)(1) through (C)(3).~~ located at each service equipment location to which the PV systems are connected or at an approved readily visible location and shall indicate the location of all identified rapid shutdown initiation devices, if not at the same location. The label shall include a simple diagram of a building with a roof and shall include the following words:

SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN.

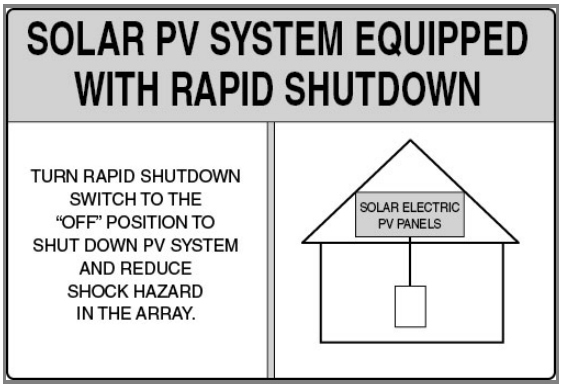
TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY.

The title "SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN" shall utilize capitalized characters with a minimum height of 9.5 mm (⅜ in.) in black on yellow background, and the remaining characters shall be capitalized with a minimum height of 4.8 mm (³⁄₁₆ in.) in black on white background. ~~*[See Figure 690.56(C)(1)(a).]*~~

Informational Note: See Informational Note Figure 690.56(C) .

Figure 690.56(C) Label for Roof-Mounted PV Systems ~~that Shut Down the Array and the Conductors Leaving the Array~~ .

DELETED



(1) Rapid Shutdown Type.

The type of PV system rapid shutdown shall be labeled as described in 690.56(C)(1)(a) or (1)(b):

(0) For PV systems that shut down the array and conductors leaving the array:

(0) For PV systems that only shut down conductors leaving the array:

SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN
TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUT DOWN CONDUCTORS OUTSIDE THE ARRAY. CONDUCTORS IN ARRAY REMAIN ENERGIZED IN SUNLIGHT.

The title "SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN" shall utilize capitalized characters with a minimum height of 9.5 mm ($^{3}/_{8}$ in.) in white on red background, and the remaining characters shall be capitalized with a minimum height of 4.8 mm ($^{3}/_{16}$ in.) in black on white background. *[See Figure 690.56(C)(1)(b).]*

Figure 690.56(C) Label for PV Systems that Shut Down the Conductors Leaving the Array Only.

The labels in 690.56(C)(1)(a) and (b) shall include a simple diagram of a building with a roof. The diagram shall have sections in red to signify sections of the PV system that are not shut down when the rapid shutdown switch is operated.

The rapid shutdown label in 690.56(C)(1) shall be located on or no more than 1 m (3 ft) from the service disconnecting means to which the PV systems are connected and shall indicate the location of all identified rapid shutdown switches if not at the same location.

(1) Buildings with More Than One Rapid Shutdown Type.

For buildings that have PV systems with ~~both~~ more than one rapid shutdown types ~~or a PV system with a rapid shutdown type and a PV system~~ with no rapid shutdown, a detailed plan view diagram of the roof shall be provided showing each different PV system and a dotted line around areas that remain energized after the rapid shutdown switch is operated.

(2) Rapid Shutdown Switch.

A rapid shutdown switch shall have a label that includes the following wording located on or no more than 1 m (3 ft) from the switch ~~that includes the following wording~~ :

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

The label shall be reflective, with all letters capitalized and having a minimum height of 9.5 mm (⅜ in.) in white on red background.

Supplemental Information

File Name	Description	Approved
FR-8715_690.56_C_for_confirmation_with_some_edits_by_chris_.docx	clean version of revision -- staff use only	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 14:07:02 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Several changes are made to the existing language in 690.56(C) to address the updated requirements in 690.12 that no longer provide a delayed enforcement date for 690.12(B)(2).

In several places the existing language has been rearranged and updated to provide improved clarity. Additionally 690.12(C)(1) has been changed to remove the option for the label, previously listed under 690.56(C)(1)(b), since this label now describes a shutdown method that is no longer Code compliant.

The title of the figure has been changed to identify this figure as an informational note to clarify that the label as shown is merely an example of a rapid shutdown system label. Other label arrangements and/or diagrams are acceptable.

Existing language in 690.12(C)(2), which has become (C)(1), has been changed to simplify the requirement to address all potential PV shutdown types, including an existing PV system without shutdown.

Changes in 690.12(C)(3), which has become (C)(2), have been made to keep terminology consistent with the naming of this device in 690.12.

Language in this section also incorporates the changes made to NFPA 70 – 2017 edition in TIA 17-1 issued 8-4-2016.

Response Message:

Committee Notes:

Date	Submitted By	
Jan 18, 2018	NEC-CMP Panel 04	Figure 690.56(C)(1)(b) is being deleted through this revision.

Public Input No. 2783-NFPA 70-2017 [Section No. 690.56(C)]

Public Input No. 3972-NFPA 70-2017 [Section No. 690.56(C)]

Public Input No. 2838-NFPA 70-2017 [Section No. 690.56(C)]

Public Input No. 3724-NFPA 70-2017 [Section No. 690.56(C)(1)]

Editorial Comment

Click here

First Revision No. 8429-NFPA 70-2018 [Section No. 690.59]

690.59 Connection to Other Sources.

PV systems connected to other sources shall be installed in accordance with Parts I and II of Article 705 and Article 712 .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 16:46:19 EST 2018

Committee Statement and Meeting Notes

Committee Statement: A reference to Article 712 has been made to recognize that both PV systems and other types of power sources could have either ac or dc outputs and interconnections.
Response Message:

First Revision No. 8585-NFPA 70-2018 [Section No. 691.1]

691.1 Scope.

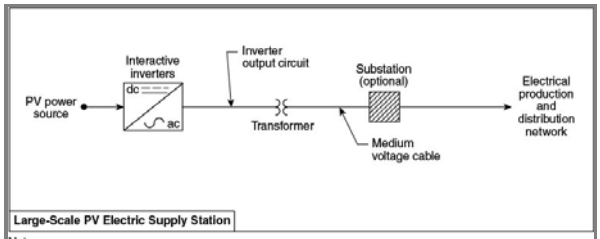
This article covers the installation of large-scale PV electric ~~power production facilities with a~~ supply stations with an inverter generating capacity of no less than 5000 kW, and not under exclusive utility control.

Informational Note No. 1: Facilities covered by this article have specific design and safety features unique to large-scale PV facilities and are operated for the sole purpose of providing electric supply to a system operated by a regulated utility for the transfer of electric energy.

Informational Note No. 2: Section 90.2(B)(5) includes information about utility-owned properties not covered under this *Code*. For additional information on electric supply stations, see ANSI/IEEE C2-~~2012~~ 2017 , *National Electrical Safety Code*.

Informational Note No. 3: See Informational Note Figure 691.1.

Figure Informational Note Figure 691.1 Identification of Large Scale PV Electric Supply Station Components.



Supplemental Information

File Name	Description	Approved
attachement_for_FR-8585.pdf	new informational note figure for large scale systems--for staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 14:40:31 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The term “power production facility” is only used in the title and scope of Article 691, and is inconsistent with the term “supply station” which is used 12 times throughout Article 691. Utilizing the term “supply station” better aligns the NEC and NESC on this term which is describing the same equipment set in both codes.

Informational Note No.2 has been updated to the current edition of the NESC.

The new Informational Note No. 3 figure will help in identification of unique system components related to large scale PV electrical supply stations that are not otherwise covered in the Informational Note

Figures 690.1(a) and 690.1(b). This drawing is meant as an aid in interpretation.

The scope is updated to align with the definition of generating capacity.

Response Message:

Public Input No. 2999-NFPA 70-2017 [Section No. 691.1]

Public Input No. 2937-NFPA 70-2017 [Global Input]

Editorial Comment

Click here

First Revision No. 8947-NFPA 70-2018 [Definition: Generating Capacity.]

~~**Generating Capacity.**~~

~~The sum of the parallel-connected inverter rated maximum continuous output power at 40°C in kilowatts (kW).~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 24 08:49:55 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition of “generating capacity” is deleted to have the Article 100 definition applicable throughout the Code.
Response Message:

First Revision No. 8948-NFPA 70-2018 [Section No. 691.4]

691.4 Special Requirements for Large-Scale PV Electric Supply Stations.

Large-scale PV electric supply stations shall be accessible only to authorized personnel and comply with the following:

(1) Electrical circuits and equipment shall be maintained and operated only by qualified personnel.

Informational Note: Refer to *NFPA 70E*-~~2015~~ 2018 , *Standard for Electrical Safety in the Workplace*, for electrical safety requirements.

(2) Access to PV electric supply stations shall be restricted by fencing or other adequate means in accordance with 110.31. Field-applied hazard markings shall be applied in accordance with 110.21(B).

(3) The connection between the PV electric supply station and the system operated by a utility for the transfer of electrical energy shall be through medium- or high-voltage switch gear, substation, switch yard, or similar methods whose sole purpose shall be to safely and effectively interconnect the two systems.

(4) The electrical loads within the PV electric supply station shall only be used to power auxiliary equipment for the generation of the PV power.

(5) Large-scale PV electric supply stations shall not be installed on buildings.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 24 08:58:04 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The referenced standard is updated to the current edition.
Response Message:

Editorial Comment

Click here

First Revision No. 8435-NFPA 70-2018 [Section No. 691.5]

691.5 Equipment ~~Approval~~ .

All electrical equipment shall be approved for installation by one of the following:

(1) Listing and labeling

(2) Field labeling

(3) Where products complying with 691.5(1) or (2) are not available, by engineering review validating that the electrical equipment is evaluated and tested to relevant standards or industry practice

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 17:01:34 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The term “Approval” in the title is not required, as this section can apply to equipment in general, and the selection of equipment, which must be approved by one of the means in the list. Adding “evaluated” makes the list more consistent with the process for verifying that equipment is suitable for use.

Response Message:

First Revision No. 8440-NFPA 70-2018 [Section No. 691.9]

691.9 ~~Disconnection of~~ Disconnecting Means for Isolating Photovoltaic Equipment.

Isolating devices shall ~~be permitted to be more than 1.8 m (6 ft) from the equipment where written safety procedures and conditions of maintenance and supervision ensure that only qualified persons service the~~ not be required within sight of equipment and may be located remotely from equipment. The engineered design per 691.6 shall document disconnection procedures and means of isolating equipment.

Informational Note: For information on electrical system maintenance, see NFPA 70B -2019, *Recommended Practice for Electrical Equipment Maintenance* . For information on written procedures and conditions of maintenance, including lockout/tagout procedures, see ~~NFPA 70E -2015, *Standard for Electrical Safety in the Workplace*~~ *NFPA 70E* -2018 .

Buildings whose sole purpose is to house and protect supply station equipment shall not be required to comply with 690.12. Written standard operating procedures shall be available at the site detailing necessary shutdown procedures in the event of an emergency.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 17:11:18 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The title of 691.9 is revised to be consistent with usage in Article 690.

Isolating devices are used by qualified technicians during routine tasks of operation and maintenance. In PV systems not covered by Article 691, the equipment is often easily accessible to service technicians that may not be fully familiar with the design or configuration of the system, and site-specific procedures for operations and maintenance are not normally a part of many small scale PV systems.

Per 691.4, the entire site is only accessible to authorized personnel, operated and maintained by qualified persons, and controlled access. Such a site should be expected to have written procedures for the operation and maintenance of the system, and this documentation should include means for isolating equipment.

Where such documentation is provided, it is not necessary to require that isolating devices be located within site of the equipment being isolated, or within a certain distance of equipment being isolated. Qualified persons, authorized to operate and maintain the system, and trained on the site-specific procedures for operation and maintenance of the system can be expected to safely operate and service the system under such conditions.

Response Message:

Public Input No. 2939-NFPA 70-2017 [Section No. 691.9]

Editorial Comment

Click here

First Revision No. 8444-NFPA 70-2018 [Section No. 691.11]

691.11 Fence Bonding and Grounding.

Fence grounding requirements and details shall be included in the documentation required in 691.6.

Informational Note: See 250.194 for fence bonding and grounding requirements enclosing substation portions of an electric supply station. Other portions of electric supply station fencing may be assessed based on the presence of overhead conductors, proximity to generation and distribution equipment, and associated step and touch potential.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jan 16 17:20:48 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This change clarifies the need for an assessment that must be conducted to assess step, touch, and transfer voltage potential for large scale PV system fencing. Section 250.194 applies to fence grounding around substations, however this is sometimes incorrectly interpreted as applying to all PV system perimeter fencing. There is a significant difference between the voltage potential at substations versus the voltage potential in PV systems. It is important that a study be performed to ensure the step, touch, and transfer voltages actually present meet safety requirements for PV perimeter fencing.

The new informational note clarifies that fencing need to be assessed based on the specific conditions and hazards present.

Response Message:

Public Input No. 1521-NFPA 70-2017 [Section No. 691.11]

Public Input No. 2938-NFPA 70-2017 [Section No. 691.11]

Editorial Comment

Click here

First Revision No. 8986-NFPA 70-2018 [Definition: Fuel Cell System.]

Fuel Cell System.

The complete aggregate of equipment used to convert chemical fuel into usable electricity and typically consisting of a reformer, stack, power inverter, and auxiliary equipment. (CMP-4)

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 25 15:17:37 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition has been moved to Article 100.
Response Message:

First Revision No. 8985-NFPA 70-2018 [Definition: Fuel Cell.]

Fuel Cell.

An electrochemical system that consumes fuel to produce an electric current. In such cells, the main chemical reaction used for producing electric power is not combustion. However, there may be sources of combustion used within the overall cell system, such as reformers/fuel processors. (CMP-4)

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 25 15:15:58 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition has been moved to Article 100.
Response Message:

First Revision No. 8987-NFPA 70-2018 [Definition: Interactive System.]

~~**Interactive System.**~~

~~A fuel cell system that operates in parallel with and may deliver power to an electrical production and distribution network. For the purpose of this definition, an energy storage subsystem of a fuel cell system, such as a battery, is not another electrical production source.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 25 15:19:11 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition is deleted from Article 692 to have the Article 100 definition apply.
Response Message:

First Revision No. 8988-NFPA 70-2018 [Definition: Maximum System Voltage.]

~~**Maximum System Voltage.**~~

~~The highest fuel cell inverter output voltage between any ungrounded conductors present at accessible output terminals.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 25 15:20:52 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition is removed as the term is not used in the article.
Response Message:

First Revision No. 8991-NFPA 70-2018 [Definition: Output Circuit.]

Fuel Cell Output Circuit.

The conductors used to connect the fuel cell system to its electrical point of delivery.

Informational Note: In the case of sites that have series- or parallel-connected multiple units, the term *output circuit* also refers to the conductors used to electrically interconnect the fuel cell system(s).

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 25 15:28:04 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition of output circuit was changed to fuel cell output circuit to clarify that this

definition applies only to fuel cell systems.

Response Message:

First Revision No. 8989-NFPA 70-2018 [Definition: Point of Common Coupling.]

~~**Point of Common Coupling.**~~

~~The point at which the power production and distribution network and the customer interface occurs in an interactive system. Typically, this is the load side of the power network meter.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 25 15:22:32 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition is removed as the term is not used in the article.
Response Message:

First Revision No. 8990-NFPA 70-2018 [Definition: Stand-Alone System.]

~~**Stand-Alone System.**~~

~~A fuel cell system that supplies power independently of an electrical production and distribution network.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 25 15:25:33 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition is deleted from Article 692 to have the Article 100 definition apply.
Response Message:

Public Input No. 4216-NFPA 70-2017 [Definition: Stand-Alone System.]

First Revision No. 8485-NFPA 70-2018 [Section No. 692.4(B)]

(B) Identification of Power Sources .

~~A permanent plaque or directory, denoting all electric power sources on or in the premises, shall be installed at each service equipment location.~~ Fuel cell systems shall be identified according to 692.4(B)(1) through (B)(3).

(1) Interconnected AC Systems.

Plaques or directories shall be installed in accordance with 705.10.

(2) Interconnected DC Systems.

Plaques or directories shall be installed in accordance with 712.10(A).

(3) Stand-Alone Systems.

Plaques or directories shall be installed in accordance with 710.10.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 08:25:35 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Three separate sentences where created to clearly identify the requirements for different system types to add clarity of the placarding of these systems.

Response Message:

Public Input No. 3746-NFPA 70-2017 [Section No. 692.4(B)]

Editorial Comment

Click here

First Revision No. 8489-NFPA 70-2018 [Section No. 692.10]

~~**692.10** Stand-Alone Systems.~~

~~The premises wiring system shall meet the requirements of this *Code* except as modified by 692.10(A), (B), and (C).~~

~~**(A)** Fuel Cell System Output.~~

~~The fuel cell system output from a stand-alone system shall be permitted to supply ac power to the building or structure disconnecting means at current levels below the rating of that disconnecting means.~~

~~**(B)** Sizing and Protection.~~

~~The circuit conductors between the fuel cell system(s) output and the building or structure disconnecting means shall be sized based on the output rating of the fuel cell system(s). These conductors shall be protected from overcurrents in accordance with 240.4. The overcurrent protection shall be located at the output of the fuel cell system(s).~~

~~**(C)** Single 120-Volt Nominal Supply.~~

~~The inverter output of a stand-alone fuel cell system shall be permitted to supply 120 volts, nominal, to single-phase, 3-wire 120/240-volt service equipment or distribution panels where there are no 240-volt loads and where there are no multiwire branch circuits. In all installations, the rating of the overcurrent device connected to the output of the fuel cell system(s) shall be less than the rating of the service equipment. This equipment shall be marked as follows:~~

~~WARNING~~

~~SINGLE 120-VOLT SUPPLY.~~

~~DO NOT CONNECT MULTIWIRE~~

~~BRANCH CIRCUITS!~~

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

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 08:35:58 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The requirements for stand-alone systems in Articles 690 and 694 were moved to Article 710 in the 2017 NEC. Section 692.10 is deleted as these requirements are now addressed in Article 710.
Response Message:

First Revision No. 8492-NFPA 70-2018 [Definition: Inverter Output Circuit.]

~~**Inverter Output Circuit.**~~

~~The conductors between an inverter and an ac panelboard for stand-alone systems, or the conductors between an inverter and service equipment or another electric power production source, such as a utility, for an electrical production and distribution network.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 08:51:33 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The definition of “inverter output circuit” is deleted to have the Article 100 definition apply.

Response Message:

Public Input No. 4259-NFPA 70-2017 [Definition: Inverter Output Circuit.]

First Revision No. 8501-NFPA 70-2018 [Section No. 694.7(B)]

(B) Equipment.

Wind electric systems shall be listed and labeled or field labeled for the application. Wind electric systems undergoing evaluation for type certification and listing shall be permitted to be operated in a controlled location with access limited to qualified personnel.

Informational Note: Testing for certification and listing is typically performed under the supervision of a qualified electrical testing organization. Qualified testing organizations may also be used for electrical system assessments to assist local authorities having jurisdiction.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 09:16:52 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The ability to use qualified testing organizations has been added to the informational note.
Response Message:

Editorial Comment

Click here

First Revision No. 8503-NFPA 70-2018 [Section No. 694.10(A)]

(A) Wind Turbine Output Circuits.

~~For wind turbines connected to~~ Wind turbine output circuits on or in one- and two-family dwellings~~, turbine output circuits~~ shall be permitted to have a maximum voltage up to 600 volts.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 09:21:48 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The maximum voltage for wind turbine output circuits on or in one- and two-family dwellings is limited to 600 volts.
Response Message:

First Revision No. 8514-NFPA 70-2018 [Section No. 694.22(C)(2)]

(2) Marking.

Each turbine system disconnecting means shall be permanently marked to identify it as a wind electric system disconnect. ~~A plaque shall be installed in accordance with 705.10 .~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 10:03:09 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The second sentence was deleted as the reference to 705.10 is now in 694.54.
Response Message:

Public Input No. 3735-NFPA 70-2017 [Section No. 694.22(C)(2)]

First Revision No. 8513-NFPA 70-2018 [Section No. 694.54]

694.54 Identification of Power Sources.

Wind turbine systems shall be identified according to 694.54(A) through (B).

(A) Interconnected AC Systems.

Plaques or directories shall be installed in accordance with 705.10.

(B) Interconnected DC Systems.

Plaques or directories shall be installed in accordance with 712.10(A).

(C) Stand-Alone Systems.

Plaques or directories shall be installed in accordance with 710.10.

~~**(A)** Facilities with Stand-Alone Systems.~~

~~Any structure or building with a stand-alone system and not connected to a utility service source shall have a permanent plaque or directory installed on the exterior of the building or structure at a readily visible location. The plaque or directory shall indicate the location of system disconnecting means and shall indicate that the structure contains a stand-alone electrical power system.~~

~~**(A)** Facilities with Utility Services and Wind Electric Systems.~~

~~Buildings or structures with both utility service and wind electric systems shall have a permanent plaque or directory providing the location of the service disconnecting means and the wind electric system disconnecting means.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 09:57:49 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Three separate sentences where created to clearly identify the requirements for different system types to add clarity of the placarding of these systems.

Response Message:

Public Input No. 3736-NFPA 70-2017 [Section No. 694.54]

Editorial Comment

Click here

First Revision No. 8590-NFPA 70-2018 [Definition: Interactive Inverter Output Circuit.]

~~**Interactive Inverter Output Circuit.**~~

~~The conductors between the interactive inverter and the service equipment or another electric power production source, such as a utility, for electrical production and distribution network.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 14:54:34 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This term "interactive inverter output circuit is not used in Article 705 and is self-defined.
Response Message:

First Revision No. 8592-NFPA 70-2018 [Definition: Microgrid Interconnect Device (MID).]

Microgrid Interconnect Device (MID).

A device that allows a microgrid system to separate from and reconnect ~~to~~ in parallel with a primary power source.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 14:56:19 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The addition of “in parallel with” text adds clarity.

Response Message:

Public Input No. 4340-NFPA 70-2017 [Definition: Microgrid Interconnect Device (MID).]

First Revision No. 8593-NFPA 70-2018 [Definition: Microgrid System.]

Microgrid System.

A premises wiring system that has generation, energy storage, and load(s), or any combination thereof, that includes the ability to disconnect from and parallel with the primary source.

Informational Note: The application of Article 705 to microgrid systems is limited by the exclusions in 90.2(B)(5) related to electric utilities. Additional information may be found in IEEE 1547, IEEE 2030.7, and IEEE 2030.8.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 14:59:13 EST 2018

Committee Statement and Meeting Notes

Committee Statement: A reference to IEEE 1547, 2030.7 and 2030.8 in the informational note helps to coordinate the information with other applicable standards.

Response Message:

Public Input No. 3870-NFPA 70-2017 [Definition: Microgrid System.]

Editorial Comment

Click here

First Revision No. 8595-NFPA 70-2018 [Definition: Multimode Inverter.]

~~**Multimode Inverter.**~~

~~Equipment having the capabilities of both the interactive inverter and the stand-alone inverter.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 15:03:09 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The multimode inverter definition is available in Article 100.
Response Message:

Public Input No. 2976-NFPA 70-2017 [Definition: Multimode Inverter.]

First Revision No. 8598-NFPA 70-2018 [Definition: Power Production Equipment.]

Power Production Equipment.

The generating source and all associated distribution equipment ~~associated with it~~ to the source disconnecting means that generates electricity from a source other than a utility supplied service. (CMP-4)

Informational Note: Examples of power production equipment include such items as generators, solar photovoltaic systems, and fuel cell systems.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 15:09:16 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This definition has been edited to clarify that the source disconnecting means is the line of demarcation between power production equipment and other electrical equipment.

Response Message:

Editorial Comment

Click here

First Revision No. 8596-NFPA 70-2018 [New Definition after Definition: Power Production Equipment.]

Power Source Output Circuit.

The conductors between power production equipment or a power source and the service or distribution equipment.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 15:05:15 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This new definition is needed to differentiate these conductors from feeders so that the rules for these conductors have their requirements in Article 705 rather than Chapter 2.
Response Message:

Editorial Comment

Click here

First Revision No. 8599-NFPA 70-2018 [Section No. 705.3]

~~**705.3** Other Articles.~~

~~Interconnected electric power production sources shall comply with this article and also with the applicable requirements of the articles in Table 705.3 .~~

~~Table 705.3 Other Articles~~

~~Equipment/System~~	~~Article~~
~~Generators~~	~~445~~
~~Solar photovoltaic systems~~	~~690~~
~~Fuel cell systems~~	~~692~~
~~Wind electric systems~~	~~694~~
~~Emergency systems~~	~~700~~
~~Legally required standby systems~~	~~701~~
~~Optional standby systems~~	~~702~~
~~Energy storage systems~~	~~706~~
~~Stand-alone systems~~	~~710~~
~~DC microgrids~~	~~712~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 15:11:54 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Section 705.3 is unnecessary.
Response Message:

Public Input No. 4054-NFPA 70-2017 [Section No. 705.3]

First Revision No. 8602-NFPA 70-2018 [Section No. 705.6]

705.6 Equipment Approval.

All equipment shall be approved for the intended use. Interactive ~~inverters for interconnection to systems interactive~~ equipment intended to operate in parallel with ~~the~~ electric power ~~system~~ production sources including, but not limited to, interactive inverters, engine generators, energy storage equipment, and wind turbines shall be listed ~~and~~ or field labeled, or both, for the intended use of interconnection service.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 15:14:43 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision addresses the fact that all interactive equipment, not just inverters, are required to be listed or field labeled for interaction with all power sources, not just utility sources.

Response Message:

Public Input No. 3027-NFPA 70-2017 [Section No. 705.6]

Editorial Comment

Click here

First Revision No. 8608-NFPA 70-2018 [New Section after 705.10]

705.11 Supply-Side Source Connections.

An electric power production source, where connected on the supply side of the service disconnecting means as permitted in 230.82(6), shall comply with 705.11(A) through (F).

(A) Output Rating.

The sum of the power source continuous current output ratings on a service, other than those controlled in accordance with 705.13 , shall not exceed the ampacity of the service conductors.

Informational Note: See Article 100 definition for Service Conductors.

(B) Conductors.

The power source output circuit conductors from the service conductors point of connection to the first overcurrent protection device shall be sized in accordance with 705.28 and in no case sized smaller than #6 AWG copper or #4 AWG aluminum. These conductors shall be installed in accordance with 230.30 or 230.43.

(C) Overcurrent Protection.

The power source output circuit conductors shall be protected from overcurrent in accordance with 705.28 and 705.30 . If fuses are not integral with the disconnecting means the disconnecting means shall be located on the service side of the fuses. Where the power source output circuit conductors make their connection to the service outside of a building, they shall be protected by overcurrent devices in a readily accessible location outside the building or at the first readily accessible location where the power source conductors enter the building. Where the power source output circuit conductors make their connection to the service inside a building, they shall be protected with one of the following methods:

(1) Within 5 m (16.5 ft). With an overcurrent device within 5 m (16.5 ft) of conductor length from the point of connection to the service

(2) Within 20 m (71 ft). With cable limiters at the connection to the service and an overcurrent device located within 20 m (71 ft) of conductor length from the point of connection to the service

(D) Bonding and Grounding.

All metal enclosures, metallic wiring methods, and metal parts associated with the power source output conductors in 705.11(B) shall be bonded in accordance with 250.92(B). This metallic equipment shall be connected to the grounding electrode system for the service at the power source disconnecting means with only one of the methods in 705.11(D)(1) or (D)(2). Where the power sources use a grounded conductor, 705.11(D)(1) shall apply.

(1) Grounded Conductor Brought to Power Source Disconnecting Means.

Where a grounded service conductor is brought to the power source disconnecting means, the grounded conductor shall be connected to the disconnecting means grounded conductor terminal or bus. A bonding conductor shall connect the grounded service conductor to the metallic equipment enclosing the power source output circuit conductors. This bonding conductor shall be sized in accordance with 250.102 based on the size of the power source output circuit conductors.

(2) Grounded Conductor Not Brought to Power Source Disconnecting Means.

Where a grounded service conductor is not brought to the power source disconnecting means, the metallic equipment enclosing the power source output circuit conductors shall be bonded to the grounding electrode system using a separate bonding conductor sized in accordance with 250.102 based on the size of the power source output circuit conductors.

(E) Connections.

The connection of power source output circuit conductors to the service conductors shall be made using listed connectors as described in 110.14 and comply with all enclosure fill requirements Any modifications to existing equipment shall be made in accordance with the manufacturer's instructions or the modification must be field labeled.

Informational Note: Electric utilities enforce their requirements for connections to equipment under their control. See 90.2.

(F) Disconnecting Means.

The power source disconnecting means shall meet the requirements of 705.20 . The power source disconnecting means shall not be considered as one of the service disconnecting means as required by 230.70. The requirements of 230.71 or 230.72 shall not apply to the power source disconnecting means. The conductors between the point of connection and the disconnect shall be connected to the line side of the disconnect.

(G) Ground-Fault Protection.

For connections rated 1000 amperes or more to solidly grounded wye services exceeding 150 volts to ground but not exceeding 1000 volts, phase-to-phase, ground-fault protection meeting the requirements of 230.95 shall be provided.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 15:27:27 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision addresses connections made by electric power production sources on the supply side of the service disconnecting means. Rather than making numerous references to Article 230 and Article 250, most of the requirements are specifically called out in the new 705.11. There are references to wiring methods in 230.30 and 230.43 since those wiring methods are for similar conductors on the supply side of a service disconnect.

The output rating limit is expressed as the sum of continuous currents from the various non-controlled power production sources. Sources that comply with the new 705.13 can be curtailed based on the ampacity of the service conductors and could be completely shut down if the non-controlled sources began to approach the ampacity of the service conductors.

The point of connection section, 705.12, has been divided into two sections. 705.12(A) has been moved to 705.11, Supply Side Source Connections and 705.12(B) has become 705.12 with the new title "Load Side Source Connections."

The language in 705.12(A) is preserved in the charging paragraph with the reference to 230.82(6). The overcurrent requirements are revised and moved from 705.12(A) into 705.11(A), Output Rating. Rather than limiting the sum of all overcurrent devices connected to power production sources, the limitation is the ampacity of the service conductors.

Section 705.11(B) sets a minimum conductor size of 6 AWG copper and 4 AWG aluminum for connections on the supply side of the service disconnecting means. The references to 230.30 and 230.43 are intended to limit the allowed wiring methods to the same methods allowed for service conductors on the supply side of the service disconnect.

Section 705.11(C) sets forth the requirements for overcurrent protection of the power source output conductors. This section also states that the overcurrent protection be located in a readily accessible location either outside of a building or at the first point of entry. If the service is inside a building, two options are available for the location of overcurrent protection. These options come from 705.31 expanding the distance from to 5m for the distance to an overcurrent device without current limiters and further limits the furthest distance allowed for installations with current limiters to 20m.

Section 705.11(D) deals with the grounding and bonding of metal equipment associated with conductors connected on the supply side of the service disconnect. The equipment is to be bonded in a similar way as service equipment. The primary difference in how it is connected to the grounding electrode system depends on whether or not a grounded conductor is brought to the power source disconnect. The size of the bonding conductor is based on the size of the power source output circuit conductors and not on the size of the service conductors.

Section 705.11(E) covers the type of connections that are permitted for conductors. The connections must be made with listed connectors. The last sentence clarifies that modifications to existing equipment must be covered in the manufacturer's instructions or get a field evaluation and label to certify the connection. The informational note under (E) was added to clarify that supply side installation should not cross into the utility owned equipment.

Section 705.11(F) clarifies that a power source disconnecting means does not count toward the maximum of six disconnects discussed in 230.71 and is not required to be grouped in accordance 230.72. The disconnect must comply with 705.20 as it will often be the source disconnect.

In 705.11(G), a reference to 230.95 was added since the requirements of 230.95 address failures on systems above 150V to ground due to ground faults. These were due to relatively slow clearing times for ground-fault current. The same hazard exists for connections to the supply side of a service.

Response Message:

Public Input No. 3750-NFPA 70-2017 [Section No. 705.31]

Public Input No. 1672-NFPA 70-2017 [Section No. 705.12(A)]

Public Input No. 3428-NFPA 70-2017 [Section No. 705.31]

Public Input No. 4107-NFPA 70-2017 [Section No. 705.12(A)]

Public Input No. 1292-NFPA 70-2017 [Section No. 705.31]

Public Input No. 3576-NFPA 70-2017 [Section No. 705.12(A)]

Public Input No. 3296-NFPA 70-2017 [Section No. 705.31]

Public Input No. 50-NFPA 70-2017 [Section No. 705.31]

Public Input No. 3297-NFPA 70-2017 [Section No. 705.31]

Public Input No. 3745-NFPA 70-2017 [Section No. 705.12(A)]

Public Input No. 1995-NFPA 70-2017 [New Section after 690.13(F)]

Public Input No. 3290-NFPA 70-2017 [Section No. 705.12 [Excluding any Sub-Sections]]

Editorial Comment

Click here

First Revision No. 8603-NFPA 70-2018 [Section No. 705.10]

705.10 ~~Directory.~~ Identification of Power Sources.

A permanent plaque or directory ~~denoting the location of all electric power source disconnecting means on or in the premises~~ shall be installed at each service equipment location ~~and at the location(s) of the system disconnect(s) for all electric power production sources capable of being interconnected.~~ , or at an approved readily visible location. The plaque or directory shall denote the location of each power source disconnecting means for the premises or be grouped with other plaques or directories for other on-site sources. The plaque or directory shall be marked with the wording “CAUTION: MULTIPLE SOURCES OF POWER”. Any diagrams shall be correctly oriented with respect to the diagram's location. The marking shall comply with 110.21(B).

Exception: Installations with ~~large numbers of~~ multiple co-located power production sources shall be permitted to be ~~designated by groups~~ identified as a group(s). The plaque or directory shall not be required to identify each power source individually.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 17 15:19:18 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Section 705.10 is revised to address the concern of providing a directory to locate all onsite power sources for a building and to standardize the placard locations and content with similar requirements in other articles.

Public Input No. 3561-NFPA 70-2017 [Section No. 705.10]

Public Input No. 4185-NFPA 70-2017 [Section No. 705.10]

Editorial Comment

Click here

First Revision No. 8745-NFPA 70-2018 [New Section after 705.12]

705.13 Power Control Systems.

A power control system (PCS) is a system that controls the output of one or more power production sources, energy storage systems (ESS), and other equipment. The PCS limits current and loading on the busbars and conductors supplied by the PCS.

The sum of the individual production power source output ratings of all sources controlled by a PCS shall be permitted to exceed the rating of the busbars or the ampacity of the conductors supplied by the PCS-controlled power production sources. A PCS shall be listed for the purpose and installed in accordance with the following:

(1) The PCS shall monitor or control all currents supplying a busbar or conductor. The PCS listing shall include functionality as an overcurrent protective device.

(2) The sum of all controlled power source currents plus all monitored currents from other sources of supply shall not exceed the ratings of any busbar conductor ampacity supplied by the power production source currents.

(3) The rating of any single power source output overcurrent protective device shall not exceed the rating of the busbar or the ampacity of the conductors to which it is connected.

(4) The controlled maximum continuous output setting of the PCS controller shall be used as the power source output current rating used for the calculation of currents in connections complying with 705.11 or 705.12 .

(5) The access to power control settings of the PCS shall be restricted to qualified personnel only in accordance with the requirements of 240.6(C)(1), (C)(2), or (C)(3).

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 16:55:22 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Multiple energy source situations are becoming more common and include systems employing multiple variable sources and energy storage systems (ESS). Without the power control system, when all outputs are maximized at the same time, they could result in an overloaded circuit.

The use of a power control system that involves monitoring and control of all of the individual sources can prevent the feeder or busbar from being over loaded, while at the same time making most efficient use of the variable resources. The requirement that the feeder or busbar supplied by multiple power sources having an output overcurrent device rated the same as the circuit or busbar ensures that the feeder or busbar is protected if any control failure should occur in the energy management system. In the event that the busbar or feeder has multiple outputs (loads), the sum of all output overcurrent protective devices will be limited to the busbar rating or the feeder ampacity.

Response Message:

Public Input No. 3292-NFPA 70-2017 [New Section after 705.12]

Editorial Comment

Click here

First Revision No. 8902-NFPA 70-2018 [Section No. 705.12]

705.12 ~~Point of Connection~~ Load-Side Source Connections .

~~The output of an interconnected electric power source shall be connected as specified in 705.12(A) or (B).~~ The output of an interconnected electric power source 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 other power source(s), and where this distribution equipment is capable of supplying multiple branch circuits or feeders, or both, the interconnecting provisions for other power sources shall comply with 705.12(A) through (E).

~~**(A)** Supply Side.~~

~~An electric power production source shall be permitted to be connected to the supply side of the service disconnecting means as permitted in 230.82(6) . The sum of the ratings of all overcurrent devices connected to power production sources shall not exceed the rating of the service.~~

(A) Dedicated Overcurrent and Disconnect.

Each source interconnection of one or more power sources installed in one system shall be made at a dedicated circuit breaker or fusible disconnecting means.

(B) Bus or Conductor Ampere Rating.

One hundred twenty-five percent of the power source output circuit current shall be used in ampacity calculations for the following:

(1) ~~*Feeders* .~~ Where the power source output connection is made to a feeder, the feeder shall have an ampacity greater than or equal to 125 percent of the power-source output circuit current. Where the power-source output connection is made to a feeder at a location other than the opposite end of the feeder from the primary source overcurrent device, that portion of the feeder on the load side of the power source output connection shall be protected by one of the following:

a. The feeder ampacity shall be not less than the sum of the primary source overcurrent device and 125 percent of the power-source output circuit current.

b. An overcurrent device ~~on~~ at the load side of the power source connection point shall be rated not greater than the ampacity of the feeder.

(2) ~~*Taps* . In systems where~~ Where power source output connections are made at feeders, ~~any~~ all taps shall be sized based on the sum of 125 percent of ~~the~~ all power source(s) output circuit current(s) and the rating of the overcurrent device protecting the feeder conductors ~~as calculated~~ for sizing tap conductors using the calculations in 240.21(B).

(3) ~~*Busbars* .~~ One of the following methods ~~that follows~~ shall be used to determine the ratings of busbars ~~in panelboards.~~ :

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

(b) Where two sources, one a primary power source and the other another power source, are located at opposite ends of a busbar that contains loads, the sum of 125 percent of the power-source(s) output circuit current and the rating of the overcurrent device protecting the busbar shall not exceed 120 percent of the ampacity of the busbar. The busbar shall be sized for the loads connected in accordance with Article 220. A permanent warning label shall be applied to the distribution equipment adjacent to the back-fed breaker from the power source that displays the following or equivalent wording:

WARNING:
POWER SOURCE OUTPUT CONNECTION —
DO NOT RELOCATE THIS OVERCURRENT DEVICE.

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

(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 displaying 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) A connection at either end~~, but not both ends,~~ of a center-fed panelboard in dwellings shall be permitted where the sum of 125 percent of the power-source(s) output circuit current and the rating of the overcurrent device protecting the busbar does not exceed 120 percent of the current rating of the busbar.

(e) Connections shall be permitted on ~~multiple-ampacity busbars~~ switchgear, switchboards, and panelboards in configurations other than those permitted in 705.12(B)(3)(a) through (d) where designed under engineering supervision that includes available fault-current and busbar load calculations.

(f) Connections shall be permitted on busbars that supply feed-through lugs and conductors connected to the lugs opposite the main source of supply. The ampacity of the busbar and connected feeders shall not be less than the sum of the primary source overcurrent device and 125 percent of the power-source output circuit current.

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

(C) 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.

(D) Suitable for Backfeed.

Fused disconnects, unless otherwise marked, shall be suitable for backfeed. Circuit breakers, if backfed, shall be suitable for such operation.

Informational Note: ~~Fused disconnects, unless otherwise marked, are suitable for backfeeding.~~ Circuit breakers marked “line” and “load” may not be suitable for backfeed or reverse current.

(E) Fastening.

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

~~**(F)** Load Side.~~

~~**(1)** Dedicated Overcurrent and Disconnect.~~

~~Each source interconnection of one or more power sources installed in one system shall be made at a dedicated circuit breaker or fusible disconnecting means.~~

~~**(2)** Bus or Conductor Ampere Rating.~~

One hundred twenty-five percent of the power source output circuit current shall be used in ampacity calculations for the following:

(0) *Feeders* . Where the power source output connection is made to a feeder at a location other than the opposite end of the feeder from the primary source overcurrent device, that portion of the feeder on the load side of the power source output connection shall be protected by one of the following:

0. The feeder ampacity shall be not less than the sum of the primary source overcurrent device and 125 percent of the power source output circuit current.

0. An overcurrent device on the load side of the power source connection shall be rated not greater than the ampacity of the feeder.

(0) *Taps* . In systems where power source output connections are made at feeders, any taps shall be sized based on the sum of 125 percent of the power source(s) output circuit current and the rating of the overcurrent device protecting the feeder conductors as calculated in 240.21(B) .

(0) *Busbars* . One of the methods that follows shall be used to determine the ratings of busbars in panelboards.

(0) The sum of 125 percent of the power source(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 busbars or their locations.

(0) Where two sources, one a primary power source and the other another power source, are located at opposite ends of a busbar that contains loads, the sum of 125 percent of the power source(s) output circuit current and the rating of the overcurrent device protecting the busbar shall not exceed 120 percent of the ampacity of the busbar. The busbar shall be sized for the loads connected in accordance with Article 220 . A permanent warning label shall be applied to the distribution equipment adjacent to the back-fed breaker from the power source that displays the following or equivalent wording:

WARNING:
POWER SOURCE OUTPUT CONNECTION —
DO NOT RELOCATE THIS OVERCURRENT DEVICE.

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

(0) 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 displaying 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) .

(0) A connection at either end, but not both ends, of a center-fed panelboard in dwellings shall be permitted where the sum of 125 percent of the power source(s) output circuit current and the rating of the overcurrent device protecting the busbar does not exceed 120 percent of the current rating of the busbar.

(0) Connections shall be permitted on multiple-ampacity busbars where designed under engineering supervision that includes available fault current 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 electric power sources that are listed and identified as interactive shall be permitted to omit the additional fastener normally required by 408.36(D) for such applications.~~

~~**(1)** 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.~~

~~**(2)** Suitable for Backfeed.~~

~~Circuit breakers, if backfed, shall be suitable for such operation.~~

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

~~**(3)** Fastening.~~

~~Listed plug-in-type circuit breakers backfed from electric power sources that are listed and identified as interactive shall be permitted to omit the additional fastener normally required by 408.36(D) for such applications.~~

Supplemental Information

File Name	Description	Approved
Panel_4_FR-8902_705.12_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jan 22 10:44:34 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision coincides with the reorganization of supply side connections into 705.11. The revisions in 705.11 require new titles for 705.12 and subsections.

The revisions to former (B)(2)(1) are made to clarify the power source connections to feeders.

This revision to former (B)(2)(2) is made to clarify the requirements when more than one power source is tapped to a feeder.

The term “in panelboards” was deleted from frormer (B)(2)(3) to clarify that this section applies to busbars in other equipment

This revision clarifies that connections can be made at both ends of a center-fed panel, provided the ampacity is not exceeded

The new language acknowledges that the requirement in 705.12(B) only specifically mentions panelboards. Special calculations can be done for panelboards, switchgear and switchboards, including center fed. These were not mentioned and have far less issues with thermal loading than do panelboards given the much larger spacings around busbars and overcurrent protection.

This revision adds a new item 705.12(B)(3)(f) with additional requirements for busbars with feed through lugs.

Language in 705.12(B)(2(3)(e) has been revised to reinstate the allowance that previously existed in NEC 2014 for connections to non-dwelling center-fed busbars under engineering supervision. Rather than singling out specific installations, the new language acknowledges that the requirement in 705.12(B) only specifically mentions panelboards.

This revision moves the first sentence of informational note to 705.12(D) into the body of the Code as the first sentence. Th added language is correlated with a similar informational note in 690.13.

Response Message:

Public Input No. 3294-NFPA 70-2017 [Section No. 705.12(B)(2)]

Public Input No. 3293-NFPA 70-2017 [Section No. 705.12(B)(2)]

Public Input No. 4119-NFPA 70-2017 [Section No. 705.12(B)(2)]

Public Input No. 404-NFPA 70-2017 [New Section after 705.12(B)(2)]

Public Input No. 3030-NFPA 70-2017 [Section No. 705.12(B)(2)]

Public Input No. 3295-NFPA 70-2017 [Section No. 705.12(B)(2)]

Editorial Comment

Click here

First Revision No. 8747-NFPA 70-2018 [Sections 705.20, 705.21, 705.22]

705.20 Disconnecting Means, ~~Sources~~ Source .

Means shall be provided to disconnect all ~~ungrounded~~ conductors that are not solidly grounded of an electric power production source(s) from all other conductors.

The disconnecting means ~~for ungrounded conductors~~ shall consist of a manual or power operated switch(es) or circuit breaker(s) that complies with the following:

(1) Located where readily accessible

(2) Externally operable without exposing the operator to contact with live parts and, if power operated, of a type that is opened by hand in the event of a power-supply failure

(3) Where disconnecting means are readily accessible to unqualified persons, any enclosure door or hinged cover that exposes live parts when open shall be locked or require a tool to open.

(4) Plainly indicate whether in the open (off) or closed (on) position

(5) Have ratings sufficient for the maximum circuit current, available ~~short-circuit~~ fault current, and voltage that is available at the terminals

(6) Where the line and load terminals are capable of being energized in the open position, marked in accordance with the warning in 690.13(B)

Informational Note : In parallel generation systems, some equipment, including knife blade switches and fuses, is likely to be energized from both directions. See 240.40.

(7) Simultaneously disconnect all ungrounded conductors of the circuit

(8) Be lockable in the open (off) position in accordance with 110.25

(9) Disconnecting means shall be one of the following:

(a) A manually operable switch or circuit breaker

(b) A load-break-rated pull-out switch

(c) A remote-controlled switch or circuit breaker that is operable locally and opens automatically when control power is interrupted

(d) A device listed or approved for the intended application

~~**705.21** Disconnecting Means, Equipment.~~

~~Means shall be provided to disconnect power production equipment, such as interactive inverters or transformers associated with a power production source, from all ungrounded conductors of all sources of supply. Equipment intended to be operated and maintained as an integral part of a power production source exceeding 1000 volts shall not be required to have a disconnecting means.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 17:03:48 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The plural is removed from “sources” in the title as “source disconnecting means” is the terminology, not “sources disconnecting means”.

The term ungrounded is deleted from the first sentence and replaced with the phrase “that are not solidly grounded”. Additionally Item (9) is added to the list of requirements for the disconnecting means for consistency with actions taken in 690.13.

The language in 705.21 has become unnecessary as revisions have been made to other articles covering a particular power source. Requirements for equipment disconnecting means for equipment that is part of an interconnected power production source system are best addressed in the specific articles applying to each source type (i.e. Articles 445, 690, 692, 694, 706). Disconnecting means to isolated each power production source (including all it's equipment) from any other power source is covered in 705.20, 705.22, and 705.23.

The first sentence from 705.22 is revised to remove the phrase “for ungrounded conductors” as it is unnecessary.

Existing 705.22(4) is revised to address fault current terminology.

This revision uses a similar format to 110.31(D) which addresses equipment accessible to unqualified persons. The installation of these systems has created an opportunity for placement of disconnect switches in locations that are accessible by other than qualified personnel. The disconnect enclosures can often be easily opened exposing potentially life threating voltages and current levels if contacted by personnel. The disconnect equipment is being installed on accessible external and internal surfaces of dwellings, in garages, and in almost any room except bathrooms in dwellings. An opened disconnect enclosure contains wiring and terminals that can be touched with tools, probes or hands. There is a need to require, as a minimum, a tool to physically open these enclosures.

Response Message:

Public Input No. 422-NFPA 70-2017 [New Section after 705.21]

Public Input No. 4047-NFPA 70-2017 [Section No. 705.22]

Public Input No. 4170-NFPA 70-2017 [Section No. 705.21]

Public Input No. 1291-NFPA 70-2017 [Section No. 705.22]

Editorial Comment

Click here

First Revision No. 8660-NFPA 70-2018 [New Section after 705.22]

705.25 Wiring Methods.

(A) General.

All raceway and cable wiring methods included in Chapter 3 of this *Code* and other wiring systems and fittings specifically listed, intended, and identified for use with power production systems and equipment shall be permitted. Where wiring devices with integral enclosures are used, sufficient length of cable shall be provided to facilitate replacement.

(B) Flexible Cords and Cables.

Flexible cords and cables, where used to connect the moving parts of a power production system or where used for ready removal for maintenance and repair, shall comply with Article 400 and shall be listed and identified as DG Cable, Distributed Generation Cable, hard service cord, or portable power cable, shall be suitable for extra-hard usage, shall be listed for outdoor use, and shall be water resistant. Cables exposed to sunlight shall be sunlight resistant. Flexible, fine-stranded cables shall be terminated only with terminals, lugs, devices, or connectors in accordance with 110.14(A).

(C) Multiconductor Cable Assemblies.

Multiconductor cable assemblies used in accordance with their listings shall be permitted.

Informational Note: See UL 3003, *Distributed Generation Cables* , for additional information on DG Cable, Distributed Generation Cable. An ac module harness is one example of a multiconductor cable assembly.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 09:47:44 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This new section is consistent with with revisions to 690.31 such that a multiconductor assembly is to be used in accordance with its listing. Type DG cable is closely related to Type TC-ER, but allows for different variations in conductor combinations within a single jacket.

Response Message:

Public Input No. 3950-NFPA 70-2017 [New Section after 705.23]

Editorial Comment

Click here

First Revision No. 8663-NFPA 70-2018 [New Section after 705.23]

705.28 Circuit Sizing and Current.

(A) Calculation of Maximum Circuit Current.

The maximum current for the circuit shall be the continuous output current rating of the power source.

(B) Conductor Ampacity.

The loads on power source output circuit conductors are continuous currents. The circuit conductors shall be sized to carry not less than 125 percent of the maximum currents as calculated in 705.28(B) . Power source output circuit conductors that are connected to a feeder, if smaller than the feeder conductors, shall be sized to carry not less than the larger of the current as calculated in 705.28(B) or as calculated in accordance with 240.21(B) based on the over-current device protecting the feeder.

(C) Ampacity of Neutral Conductor.

The ampacity of the neutral conductors shall comply with either 705.28(C) (1) or (C)(2).

(1) Neutral Conductor for Single-Phase, 2-Wire Power Source Output.

If a single-phase, 2-wire power source output is connected to the neutral and one ungrounded conductor (only) of a 3-wire system or of a 3-phase, 4-wire, wye-connected system, the maximum load connected between the neutral and any one ungrounded conductor plus the power source output rating shall not exceed the ampacity of the neutral conductor.

(2) Neutral Conductor for Instrumentation, Voltage, Detection, or Phase Detection.

A conductor used solely for instrumentation, voltage detection, or phase detection, and connected to a single-phase or 3-phase power source, shall be permitted to be sized at less than the ampacity of the other current-carrying conductors and shall be sized equal to or larger than the equipment grounding conductor.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 10:02:10 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Existing 705.60 and 705.65 have been revised, consolidated and relocated into 705.28 and existing 705.30 to be consistent with Article 690.

Section 705.28 contains requirements from 705.60 and placed here to be generally applicable to all systems, not just inverters. The text of former 705.60 is simplified to state that the maximum circuit current is based on the continuous current ratings of the circuit rather than addressing input and output circuits for inverters.

New 705.28(B) aligns with the changes in Article 690 for consistency and includes the sentence from 705.65(C) for conductor ampacity of inverter systems.

The language from 705.28(C) is an edited version of the requirements from 705.95.

Section 705.30 is taken from 705.65 and combined into the existing 705.30. The old 705.30(A) through

(D) are removed as the they may provide no new requirements. The exception in the new 705.30(C) [old 705.65(B)] is reworded to remove specific references to inverters and replace with power sources as in the rest of 705. 705.30(E) is revised to directly reference 445.12 as 705.130 and 705.143 are folded into Part I so that the old Parts II and III can be eliminated.

Response Message:

Committee Notes:

Date	Submitted By	
Jan 18, 2018	NEC-CMP Panel 04	THIS FIRST REVISION MUST GO WITH FR for 705.30.

Editorial Comment

Click here

First Revision No. 8659-NFPA 70-2018 [Section No. 705.23]

~~**705.23** Interactive System Disconnecting Means.~~

~~A readily accessible means shall be provided to disconnect the interactive system from all wiring systems including power systems, energy storage systems, and utilization equipment and its associated premises wiring.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 09:43:17 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This section is not needed based on first revisions made in Article 705.

First Revision No. 8964-NFPA 70-2018 [Section No. 705.30]

705.30 Overcurrent Protection.

~~Conductors shall be protected in accordance with Article 240 . Equipment and conductors connected to more than one electrical source shall have a sufficient number of overcurrent devices located so as to provide protection from all sources.~~

(A) ~~Solar Photovoltaic Systems~~ Circuit and Equipment .

~~Solar photovoltaic systems shall be protected in accordance with Article 690~~ Power source output circuit conductors and equipment shall be protected in accordance with Article 240. Circuits connected to more than one electrical source shall have overcurrent devices located so as to provide overcurrent protection from all sources .

(B) ~~Transformers~~ Overcurrent Device Ratings .

~~Overcurrent protection for a transformer with a source(s) on each side shall be provided in accordance with 450.3 by considering first one side of the transformer, then the other side of the transformer, as the primary.~~ The overcurrent devices in other than generator systems shall be sized to carry not less than 125 percent of the maximum currents as calculated in 705.28(A). The rating or setting of overcurrent devices shall be permitted in accordance with 240.4(B) and (C)

Exception: Circuits containing an assembly together with its overcurrent device(s) that is listed for continuous operation at 100 percent of its rating shall be permitted to be utilized at 100 percent of its rating.

(C) ~~Fuel Cell Systems~~ Power Transformers .

~~Fuel cell systems shall be protected in accordance with Article 692 .~~ Overcurrent protection for a transformer with a source(s) on each side shall be provided in accordance with 450.3 by considering first one side of the transformer, then the other side of the transformer, as the primary.

~~**(D)** Interactive Inverters.~~

~~Interactive inverters shall be protected in accordance with 705.65 .~~

(D) Generators.

Generators shall be protected in accordance with ~~705.130~~ 445.12 .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 24 11:48:53 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Revised 705.30 includes requirements taken from 705.65 and combined into the existing 705.30. The old 705.30(A) through (D) are removed as the they provide no additional requirements. The exception in the new 705.30(C) [old 705.65(B)] is reworded to remove specific references to inverters and replace with power sources as in the rest of 705. Section 705.30(E) is revised to directly reference 445.12 as 705.130 and 705.143 have been folded into Part I.

Response Message:

Editorial Comment

Click here

First Revision No. 8664-NFPA 70-2018 [Section No. 705.31]

~~**705.31** Location of Overcurrent Protection.~~

~~Overcurrent protection for electric power production source conductors, connected to the supply side of the service disconnecting means in accordance with 705.12(A) , shall be located within 3 m (10 ft) of the point where the electric power production source conductors are connected to the service.~~

~~Informational Note: This overcurrent protection protects against short-circuit current supplied from the primary source(s) of electricity.~~

~~*Exception: Where the overcurrent protection for the power production source is located more than 3 m (10 ft) from the point of connection for the electric power production source to the service, cable limiters or current-limited circuit breakers for each ungrounded conductor shall be installed at the point where the electric power production conductors are connected to the service.*~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 10:12:22 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This section has been revised and incorporated into new Section 705.11.
Response Message:

First Revision No. 8665-NFPA 70-2018 [Section No. 705.32]

705.32 Ground-Fault Protection.

Where ~~ground-fault~~ protection is ~~used~~ installed in accordance with 230.95 , the output of an interactive system shall be connected to the supply side of the ground-fault protection.

Exception: Connection shall be permitted to be made to the load side of ground-fault protection, if there is ground-fault protection for equipment from all ground-fault current sources.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 10:14:53 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This revision clarifies that this section applies to ground fault protection for services.
Response Message:

Public Input No. 3298-NFPA 70-2017 [Section No. 705.32]

First Revision No. 8750-NFPA 70-2018 [Sections 705.40, 705.42]

705.40 Loss of Primary Source.

~~Upon loss of primary source, an~~ An electric power production source shall be automatically disconnected from all ungrounded conductors of the ~~primary source and~~ interconnected systems when one of the phases opens to which it is connected. The electric power production source shall not be reconnected until all the ~~primary source is restored~~ phases of the source to which it connected are restored. This requirement shall not be applicable to an electric power production source providing power for an emergency or legally required standby system .

Exception: A listed interactive inverter shall be permitted to automatically cease exporting power ~~upon loss~~ when one of ~~primary~~ the phases of the source opens and shall not be required to automatically disconnect all ungrounded conductors from the primary source. A listed interactive inverter shall be permitted to automatically or manually resume exporting power to the utility once all phases of the ~~primary~~ source to which it is connected are restored.

Informational Note No. 1: Risks to personnel and equipment associated with the primary source could occur if an ~~utility~~ interactive electric power production source can operate as an intentional island. Special detection methods are required to determine that a primary source supply system outage has occurred and whether there should be automatic disconnection. When the primary source supply system is restored, special detection methods can be required to limit exposure of power production sources to out-of-phase reconnection.

Informational Note No. 2: Induction-generating equipment on systems with significant capacitance can become self-excited upon loss of the primary source and experience severe overvoltage as a result.

~~An interactive inverter shall be permitted to operate as a stand-alone system to supply loads that have been disconnected from electrical production and distribution network sources.~~ An interactive power production source shall be permitted to operate in a stand-alone or islanded mode to supply loads that have been disconnected from the electric power production and distribution network.

~~**705.42** Loss of 3-Phase Primary Source.~~

~~A 3-phase electric power production source shall be automatically disconnected from all ungrounded conductors of the interconnected systems when one of the phases of that source opens. This requirement shall not be applicable to an electric power production source providing power for an emergency or legally required standby system.~~

~~*Exception: A listed interactive inverter shall be permitted to automatically cease exporting power when one of the phases of the source opens and shall not be required to automatically disconnect all ungrounded conductors from the primary source. A listed interactive inverter shall be permitted to automatically or manually resume exporting power to the utility once all phases of the source are restored.*~~

Supplemental Information

File Name	Description	Approved
Panel_4_FR-8750_705.40_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 17:12:34 EST 2018

Committee Statement and Meeting Notes

Committee Statement: In the reorganization of Article 705, Sections 705.40 and 705.42 are combined. The text of 705.42 is modified to address all types of ac electrical systems and the loss of any phase in any ac system. The informational notes from 705.40 are retained in this single section.

Response Message:

Public Input No. 3519-NFPA 70-2017 [Section No. 705.40]

First Revision No. 8668-NFPA 70-2018 [Section No. 705.50]

~~**705.50** Grounding.~~

~~Interconnected electric power production sources shall be grounded in accordance with Article 250 .~~

~~*Exception: For direct-current systems connected through an inverter directly to a grounded service, other methods that accomplish equivalent system protection and that utilize equipment listed and identified for the use shall be permitted.*~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 10:23:13 EST 2018

Committee Statement and Meeting Notes

Committee Statement: This section is removed as these requirements are better addressed by the individual electrical power production source articles such as Article 690.

Response Message:

Public Input No. 2061-NFPA 70-2017 [Section No. 705.50]

First Revision No. 8683-NFPA 70-2018 [Section No. 705.150]

705.150 System Operation.

Microgrid systems shall be permitted to disconnect from the primary source of power or other interconnected electric power production sources and operate ~~as a separate microgrid system~~ in stand-alone or islanded mode .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 11:18:22 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The undefined term “separate microgrid systems” has been replaced with the terms “stand-alone” and “islanded” to align with other applicable standards and other NEC articles.

Response Message:

Public Input No. 3871-NFPA 70-2017 [Section No. 705.150]

Editorial Comment

Click here

First Revision No. 8687-NFPA 70-2018 [Section No. 705.160]

705.160 Primary Power Source Connection.

Connections to primary power sources that are external to the microgrid system shall comply with the requirements of705.11 and 705.12. Power source conductors connecting to a microgrid system, including conductors supplying distribution equipment, shall be considered as power source output conductors.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 11:28:19 EST 2018

Committee Statement and Meeting Notes

Committee Statement: With the increase in on-site energy sources being installed and connected to serve premises distribution equipment in a microgrid application there is a need to clarify how to apply existing NEC rules to the conductors supplying loads, particularly when supplying buildings and structures. This revision provides clarity that such conductors should not be considered as service conductors, as covered in Article 230, but rather should use existing requirements in Article 215 and 225 as required for the specific application. This change will help prevent confusion and aide in the proper application of long established NEC requirements to these relatively new systems.

Response Message:

Public Input No. 4162-NFPA 70-2017 [Section No. 705.160]

First Revision No. 8720-NFPA 70-2018 [New Section after 710.1]

710.2 Definitions.

Stand-Alone (Islanded) Mode.

The mode when a multimode inverter or microgrid is disconnected from the electric power production and distribution network primary power source.

Informational Note: For isolated stand-alone systems and isolated microgrids, stand-alone or islanded mode is the primary mode of operation. Isolated microgrids are distinguished from interconnected microgrids, which are defined in 705.2.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 14:53:12 EST 2018

Committee Statement and Meeting Notes

Committee Statement: A new definition was added for clarification of a term used in Article 710.
Response Message:

Public Input No. 4196-NFPA 70-2017 [New Section after 710.1]

Editorial Comment

Click here

First Revision No. 8718-NFPA 70-2018 [Section No. 710.1]

710.1 Scope.

This article covers electric power production sources operating in stand-alone or islanded mode. It also covers installations that are not connected to an electric power production and distribution network.

Informational Note: These sources are capable of operating in stand-alone or islanded mode, independent from the electric power production and distribution network, and may be either interactive or isolated microgrid systems. Stand-alone systems may include sources such as engine generators, solar PV, wind, ESS, or batteries.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 14:47:17 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The scope was revised to address both standalone systems and modes of operation. The informational note was added to avoid conflict.

Public Input No. 4020-NFPA 70-2017 [Section No. 710.1]

Editorial Comment

Click here

First Revision No. 8721-NFPA 70-2018 [New Section after 710.6]

710.10 Identification of Power Sources.

A permanent plaque or directory shall be installed at a building supplied by a stand-alone system at each service equipment location, or at an approved readily visible location. The plaque or directory shall denote the location of each power source disconnecting means for the premises or be grouped with other plaques or directories for other on-site sources. The marking shall comply with 110.21(B).

Exception: Installations with multiple co-located power production sources shall be permitted to be identified as a group(s). The plaque or directory shall not be required to identify each power source individually.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 15:03:13 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The new section is consistent with other existing NEC requirements for plaques for on-site power sources.

Response Message:

Public Input No. 3599-NFPA 70-2017 [New Section after 710.6]

Public Input No. 3401-NFPA 70-2017 [New Section after 710.15]

Editorial Comment

Click here

First Revision No. 8724-NFPA 70-2018 [New Section after 710.6]

710.12 Stand-Alone Inverter Input Circuit Current.

The maximum current shall be the stand-alone continuous inverter input current rating when the inverter is producing rated power at the lowest input voltage.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 15:29:20 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The language was moved from 690.8(A)(4).
Response Message:

First Revision No. 8722-NFPA 70-2018 [Sections 710.15(A), 710.15(B)]

(A) Supply Output.

Power supply to premises wiring systems fed by stand-alone or isolated microgrid power sources shall be permitted to have less capacity than the calculated load. The capacity of the sum of all sources of the stand-alone supply shall be equal to or greater than the load posed by the largest single utilization equipment connected to the system. Calculated general lighting loads shall not be considered as a single load.

Informational Note: For general-use loads the system capacity can be calculated using the sum of the capacity of the firm sources, such as generators and ESS inverters. For specialty loads intended to be powered directly from a variable source, the capacity can be calculated using the sum of the variable sources, such as PV or wind inverters, or the combined capacity of both firm and variable sources.

(B) Sizing and Protection.

The circuit conductors between a stand-alone source and a building or structure disconnecting means shall be sized based on the sum of the output ratings of the stand-alone ~~sources~~ source(s) .

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 15:10:53 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The revisions in (A) clarify that in a microgrid, multiple sources can operate in parallel to support the connected loads. There is no requirement for a single source to be larger than the single largest load. "Fed by stand-alone or isolated microgrid power sources" was added to (A) to distinguish that this section applies only to stand-alone and isolated microgrid system.

The revision in (B) clarifies that the conductors must be based on the sum of all sources operating in parallel.

The informational note addresses the variable nature of some supply sources.

Response Message:

Editorial Comment

Click here

First Revision No. 8725-NFPA 70-2018 [Sections 710.15(C), 710.15(D), 710.15(E), 710.15(F)]

(C) Single 120-Volt Supply.

Stand-alone and isolated microgrid systems shall be permitted to supply 120 volts to single-phase, 3-wire, 120/240-volt service equipment or distribution panels where there are no 240-volt outlets and where there are no multiwire branch circuits. In all installations, the sum of the ratings of the power sources shall be less than the rating of the neutral bus in the service equipment. This equipment shall be marked with the following words or equivalent:

WARNING:

SINGLE 120-VOLT SUPPLY. DO NOT CONNECT MULTIWIRE BRANCH CIRCUITS!

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

(D) Energy Storage or Backup Power System Requirements.

Energy storage or backup power supplies ~~are~~ shall not be required.

(E) ~~Back-Fed~~ Backfed Circuit Breakers.

Plug-in-type ~~back-fed~~ backfed circuit breakers connected to an interconnected supply shall be secured in accordance with 408.36(D). Circuit breakers marked “line” and “load” shall not be ~~back-fed~~ backfed .

(F) Voltage and Frequency Control.

The stand-alone or isolated microgrid supply shall be controlled so that voltage and frequency remain within suitable limits for the connected loads.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 15:33:42 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The words “and isolated microgrid” were added to 710.15(C) to indicate that this section applies to both stand-alone systems and isolated microgrid systems.

The words “or isolated microgrid” were added to 710.15(F) to indicate that this section applies to both stand-alone systems and isolated microgrid systems.

Response Message:

Editorial Comment

Click here

First Revision No. 8674-NFPA 70-2018 [Sections Part II., 705.60, 705.65, 705.70, 705.80, 705.82, ...]

Part II. Interactive Inverters

705.60 Circuit Sizing and Current.

(A) Calculation of Maximum Circuit Current.

The maximum current for the specific circuit shall be calculated in accordance with 705.60(A)(1) and (A)(2).

(1) Inverter Input Circuit Currents.

The maximum current shall be the maximum rated input current of the inverter.

(2) Inverter Output Circuit Current.

The maximum current shall be the inverter continuous output current rating.

(B) Ampacity and Overcurrent Device Ratings.

Inverter system currents shall be considered to be continuous. The circuit conductors and overcurrent devices shall be sized to carry not less than 125 percent of the maximum currents as calculated in 705.60(A) . The rating or setting of overcurrent devices shall be permitted in accordance with 240.4(B) and (C).

Exception: Circuits containing an assembly together with its overcurrent device(s) that is listed for continuous operation at 100 percent of its rating shall be permitted to be utilized at 100 percent of its rating.

705.65 Overcurrent Protection.

(A) Circuits and Equipment.

Inverter input circuits, inverter output circuits, and storage battery circuit conductors and equipment shall be protected in accordance with the requirements of Article 240 . Circuits connected to more than one electrical source shall have overcurrent devices located so as to provide overcurrent protection from all sources.

Exception: An overcurrent device shall not be required for circuit conductors sized in accordance with 705.60(B) and located where one of the following applies:

(0) There are no external sources such as parallel-connected source circuits, batteries, or backfeed from inverters.

(0) The short-circuit currents from all sources do not exceed the ampacity of the conductors.

Informational Note: Possible backfeed of current from any source of supply, including a supply through an inverter into the inverter output circuit and inverter source circuits, is a consideration in determining whether adequate overcurrent protection from all sources is provided for conductors and modules.

(B) Power Transformers.

Overcurrent protection for a transformer with a source(s) on each side shall be provided in accordance with 450.3 by considering first one side of the transformer, then the other side of the transformer, as the primary.

Exception: A power transformer with a current rating on the side connected toward the interactive inverter output that is not less than the rated continuous output current of the inverter shall be permitted without overcurrent protection from that source.

(C) Conductor Ampacity.

Power source output circuit conductors that are connected to a feeder, if smaller than the feeder conductors, shall be sized to carry not less than the larger of the current as calculated in 705.60(B) or as calculated in accordance with 240.21(B) based on the over-current device protecting the feeder.

705.70 Interactive Inverters Mounted in Not Readily Accessible Locations.

Interactive inverters shall be permitted to be mounted on roofs or other exterior areas that are not readily accessible. These installations shall comply with (1) through (4):

(0) A dc disconnecting means shall be mounted within sight of or in the inverter.

(0) An ac disconnecting means shall be mounted within sight of or in the inverter.

(0) An additional ac disconnecting means for the inverter shall comply with 705.22 .

(0) A plaque shall be installed in accordance with 705.10 .

705.80 Utility-Interactive Power Systems Employing Energy Storage.

Utility-interactive power systems employing energy storage shall also be marked with the maximum operating voltage, including any equalization voltage, and the polarity of the grounded circuit conductor.

705.82 Hybrid Systems.

Hybrid systems shall be permitted to be interconnected with interactive inverters.

705.95 Ampacity of Neutral Conductor.

The ampacity of the neutral conductors shall comply with either (A) or (B).

(A) Neutral Conductor for Single Phase, 2-Wire Inverter Output.

If a single-phase, 2-wire inverter output is connected to the neutral and one ungrounded conductor (only) of a 3-wire system or of a 3-phase, 4-wire, wye-connected system, the maximum load connected between the neutral and any one ungrounded conductor plus the inverter output rating shall not exceed the ampacity of the neutral conductor.

(B) Neutral Conductor for Instrumentation, Voltage, Detection or Phase Detection.

A conductor used solely for instrumentation, voltage detection, or phase detection and connected to a single-phase or 3-phase interactive inverter, shall be permitted to be sized at less than the ampacity of the other current-carrying conductors and shall be sized equal to or larger than the equipment grounding conductor.

705.100 Unbalanced Interconnections.

(A) Single Phase.

Single-phase inverters for hybrid systems and ac modules in interactive hybrid systems shall be connected to 3-phase power systems in order to limit unbalanced voltages to not more than 3 percent.

> Informational Note: For interactive single-phase inverters, unbalanced voltages can be minimized by the same methods that are used for single-phase loads on a 3-phase power system. See ANSI/C84.1-2011, *Electric Power Systems and Equipment — Voltage Ratings (60 Hertz)* .

(B) Three Phase.

Three-phase inverters and 3-phase ac modules in interactive systems shall have all phases automatically de-energized upon loss of, or unbalanced, voltage in one or more phases unless the interconnected system is designed so that significant unbalanced voltages will not result.

Part III. Generators

705.130 Overcurrent Protection.

Conductors shall be protected in accordance with Article 240 . Equipment and conductors connected to more than one electrical source shall have overcurrent devices located so as to provide protection from all sources. Generators shall be protected in accordance with 445.12 .

705.143 Synchronous Generators.

Synchronous generators in a parallel system shall be provided with the necessary equipment to establish and maintain a synchronous condition.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 04

Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jan 18 10:54:37 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Parts II and III have been deleted as part of the restructuring of Article 705. Sections have been deleted or incorporated into other sections of Article 705. See FR-8747.

The existing language addresses equipment that may be part of a power production system. Deleting 705.70 improves clarity and prevent conflict so the applicable individual articles address the requirements.

The definition for "hybrid systems" and the last remaining hybrid reference later in the sentence have been removed. FR-8750 clarified that the 3 percent is to be measured at the point of interconnection.

Response Message:

Public Input No. 3754-NFPA 70-2017 [Section No. 705.70]

Public Input No. 1293-NFPA 70-2017 [Section No. 705.65(A)]

Public Input No. 3757-NFPA 70-2017 [Section No. 705.100(A)]