Second Revision No. 8293-NFPA 70-2021 [Detail]

Article 100

PV DC Circuit.(PV System DC Circuit).

Any dc conductor in PV source circuits, PV string circuits, and PV dc-to-dc converter circuits. (690) (CMP-4)

PV DC Circuit, Source. (PV Source Circuit)

The PV dc circuit conductors between modules in a PV string circuit, and from PV string circuits or dc combiners, to dc combiners, electronic power converters, or a dc PV system disconnecting means. (690) (CMP-4)

PV DC Circuit, String. (PV String Circuit)

The PV source circuit conductors of one or more series-connected PV modules. (690) (CMP-4)

Supplemental Information

File Name	Description	Approved
NEC_CMP4_SR_8293_Article100.docx	For staff use	

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 14:54:21 EDT 2021

Committee Statement

Committee Statement: Definition title is updated with alternate term (Source PV DC Circuit) and with synonym term (PV Source Circuit) per Style Manual Section 2.2.2.5. Clarification of the term PV DC Circuit, Source includes that circuits from PV dc combiners are also dc PV source circuits.

Additionally the terms PV DC Circuit, Source and PV DC Circuit, String, are made subset definitions per NEC Style Manual Section 2.2.2.3.

Response Message: SR-8293-NFPA 70-2021

Public Comment No. 1508-NFPA 70-2021 [Definition: PV DC Circuit, Source. (PV Source Circuit)]

Public Comment No. 1507-NFPA 70-2021 [Definition: PV DC Circuit, Source. (PV Source Circuit)]

Public Comment No. 1509-NFPA 70-2021 [Definition: PV DC Circuit (PV System DC Circuit).]

Public Comment No. 2221-NFPA 70-2021 [Definition: PV DC Circuit, Source. (PV Source Circuit)]

Second Revision No. 8219-NFPA 70-2021 [Definition: AC Module (Alternating-Current Module).]

Module, AC ~~Module~~ . (~~Alternating-Current~~ AC Module).~~.~~

A complete, environmentally protected unit consisting of solar cells, inverter, and other components, designed to produce ac power. (690) (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 11:00:11 EDT 2021

Committee Statement

Committee Statement: To comply with NEC Style Manual Section 2.2.2.3 and 2.2.2.3.1 for base terms and searchable terms this definition title is updated to Module, AC. (AC Module)

Response Message: SR-8219-NFPA 70-2021

Public Comment No. 1647-NFPA 70-2021 [Definition: AC Module (Alternating-Current Module).]

Second Revision No. 8220-NFPA 70-2021 [Definition: AC Module System.]

Module System, AC. (AC Module System.)

An assembly of ac modules, wiring methods, materials, and subassemblies that are evaluated, identified, and defined as a system. (690) (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 11:07:42 EDT 2021

Committee Statement

Committee Statement: To comply with NEC Style Manual Section 2.2.2.3 and 2.2.2.3.1 for base terms and searchable terms this definition title is updated to Module System, AC. (AC Module System) to Module System, AC. (AC Module System)

Response Message: SR-8220-NFPA 70-2021

Public Comment No. 1495-NFPA 70-2021 [Definition: AC Module System.]

Second Revision No. 8706-NFPA 70-2021 [Definition: DC-to-DC Converter Circuit.]

Converter Circuit, DC-to-DC. (DC-to-DC Converter Circuit.)

The dc circuit conductors cond nected to the output of a dc-to-dc converter. (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Nov 02 11:33:07 EDT 2021

Committee Statement

Committee Statement: To comply with NEC Style Manual Section 2.2.2.3 and 2.2.2.3.1 for base terms and searchable terms the definition title for this term is updated to Converter Circuit, DC-to-DC. (DC-to-DC Converter Circuit).

Response Message: SR-8706-NFPA 70-2021 See SR-8707-NFPA 70-2021 for Converter, DC-to-DC. (DC-to-DC Converter) definition update

Public Comment No. 1526-NFPA 70-2021 [Definition: DC-to-DC Converter Circuit.]

Public Comment No. 1975-NFPA 70-2021 [Definition: DC-to-DC Converter Circuit.]

Second Revision No. 8707-NFPA 70-2021 [Definition: DC-to-DC Converter.]

Converter, DC-to-DC. (DC-to-DC Converter.)

A device that can provide an output dc voltage and current at a higher or lower value than the input dc voltage and current. (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Nov 02 11:37:40 EDT 2021

Committee Statement

Committee Statement: To comply with NEC Style Manual Section 2.2.2.3 and 2.2.2.3.1 for base terms and searchable terms the definition title for this term is updated to Converter, DC-to-DC, (DC-to-DC Converter).

Response Message: SR-8707-NFPA 70-2021

Second Revision No. 8233-NFPA 70-2021 [Definition: Direct-Current (dc) Combiner.]

Combiner (DC). (dc Combiner) (Direct-Current ~~(dc)~~ Combiner.)

An enclosure that includes devices used to connect two or more PV system dc circuits in parallel. (690) (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 11:37:14 EDT 2021

Committee Statement

Committee Statement: To comply with NEC Style Manual Section 2.2.2.3 for base terms the definition title is structured as Combiner (DC). (dc Combiner) (Direct-Current Combiner)

Response Message: SR-8233-NFPA 70-2021

Public Comment No. 1503-NFPA 70-2021 [Definition: Direct-Current (dc) Combiner.]

Second Revision No. 8235-NFPA 70-2021 [Definition: Ground-Fault Detector Interrupter (GFDI).]

Ground-Fault Detector-Interrupter, dc (GFDI).

A device that provides protection for PV system dc circuits by detecting a ground fault ~~protection for PV dc circuits~~ and could interrupt the fault path in the dc circuit . (690) (CMP-4)

Informational Note: See UL 1741, *Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources* , ~~for~~ and UL 62109, *Standard for Safety of Power Converters for use in Photovoltaic Power Systems* . for further information on GFDI equipment.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 11:43:02 EDT 2021

Committee Statement

Committee Statement: The definition is updated to ensure consistency with and differentiation from ground-fault circuit interrupter terminology and with the UL 1741 product standard. UL standard 62109 is added to the informational note.

Response Message: SR-8235-NFPA 70-2021

Public Comment No. 558-NFPA 70-2021 [Definition: Ground-Fault Detector Interrupter (GFDI).]

Second Revision No. 8243-NFPA 70-2021 [Definition: Interactive Mode.]

Interactive Mode.

The operating mode for power production equipment or microgrids that ~~is operating~~ operate in parallel with and are capable of delivering energy to an electric power production and distribution network or other primary source. (CMP-4)

Informational Note: Interactive mode is an operational mode of both interactive systems and of equipment such as interactive inverters.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 12:04:39 EDT 2021

Committee Statement

Committee Statement: A reference to microgrids is added since this mode of operation is stated in Article 705 as one of the modes that microgrids are permitted to operate within. An informational note is added to clarify that an interactive mode may be part of either interactive equipment, or of an interactive system

Response Message: SR-8243-NFPA 70-2021

Public Comment No. 715-NFPA 70-2021 [Definition: Interactive Mode.]

Public Comment No. 1490-NFPA 70-2021 [Definition: Interactive Mode.]

Public Comment No. 2144-NFPA 70-2021 [Definition: Interactive Mode.]

Second Revision No. 8245-NFPA 70-2021 [Definition: Island Mode.]

Island Mode.

The operating mode for power production equipment ~~that is disconnected~~ or microgrids that allows energy to be supplied to loads that are disconnected from an electric power production and distribution network or other primary power source ~~and capable of delivering energy to loads~~ . (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 12:11:24 EDT 2021

Committee Statement

Committee Statement: The revision clarifies that it is the operating mode delivering energy to the loads, rather than the power sources. Additionally, microgrids are added since this mode of operation is stated in Article 705 as one of the modes that microgrids are permitted to operate within.

Response Message: SR-8245-NFPA 70-2021

Public Comment No. 2095-NFPA 70-2021 [Definition: Island Mode.]

Second Revision No. 8247-NFPA 70-2021 [Definition: Maximum Voltage.]

Maximum Voltage.

The ~~maximum voltage the wind turbine produces in operation including open circuit conditions~~ greatest difference in potential produced between any two conductors of a wind turbine circuit . (694) (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 12:13:31 EDT 2021

Committee Statement

Committee Statement: To comply with NEC Style Guide Section 2.2.2.2 the term has "maximum voltage" has been removed from the definition and replaced with synonymous text.

Response Message: SR-8247-NFPA 70-2021

Public Comment No. 1504-NFPA 70-2021 [Definition: Maximum Voltage.]

Second Revision No. 8252-NFPA 70-2021 [Definition: Microgrid Interconnect Device (MID).]

Microgrid Interconnect Device (MID).

A device that enables a microgrid system to ~~operate in island mode while separated from a primary source and to reconnect to the~~ separate from and reconnect to an interconnected primary power source. (CMP-4)

~~Informational Note: Microgrid controllers typically are used to measure and evaluate electrical parameters and provide the logic for the signal to initiate and complete transition processes. IEEE Std 2030.7-2017, *IEEE Standard for the Specification of Microgrid Controllers* , and IEEE Std 2030.8-2018, IEEE *Standard for the Testing of Microgrid Controllers* , provide information on microgrid controllers. IEEE Std 1547-2018, IEEE *Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces* , provides information on interconnection requirements.~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 12:23:49 EDT 2021

Committee Statement

Committee Statement: The definition has been edited to clarify that the MID is a switching device and does not control whether power sources operate in island mode.

The informational note has been deleted as the standards referenced were duplicated in the term microgrid informational note and no other clarification is necessary.

Response Message: SR-8252-NFPA 70-2021

Public Comment No. 2150-NFPA 70-2021 [Definition: Microgrid Interconnect Device (MID).]

Public Comment No. 1492-NFPA 70-2021 [Definition: Microgrid Interconnect Device (MID).]

Public Comment No. 714-NFPA 70-2021 [Definition: Microgrid Interconnect Device (MID).]

Second Revision No. 8445-NFPA 70-2021 [Definition: Microgrid System]

Microgrid ~~System~~ .

~~A system~~ An electric power system capable of operating in island mode and capable of being interconnected to an electric power production and distribution network or other primary ~~power~~ source ~~capable of~~ while operating in ~~parallel~~ interactive mode , ~~that~~ which includes the ability to disconnect from ~~the~~ and reconnect to a primary source and operate in island mode. (CMP-4)

Informational Note No. 1: ~~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.~~ See IEEE Std 1547, *IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interface* ; IEEE Std. 2030.7, *IEEE Standard for the Specification of Microgrid Controllers* ; IEEE Std. 2030.8, *IEEE Standard for the Testing of Microgrid Controllers* ; and UL1008B, *Outline for Source Interconnection* , for additional information about microgrids.

Informational Note No. 2: Examples of power sources in microgrids include such items as photovoltaic systems, generators, fuel cell systems, wind electric systems, energy storage systems, electric vehicles that are used as a source of supply, and electrical power conversion from other energy sources.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 16:05:54 EDT 2021

Committee Statement

Committee Statement: The word “system” is deleted from the defined term since it is unnecessary as it is already described as a system within the definition. This definition is adjusted to address many different configurations that are permitted to be considered a microgrid, while more clearly defining the essential elements of a microgrid.

Informational Note No. 1 has been updated to comply with NEC Style Manual Section 4.1.3. The reference to 90.2(B)(5) is deleted since it is covered in Article 90. The additional references to the standards improve the application of this definition.

A second informational note note is added to provide supplemental examples.

Response Message: SR-8445-NFPA 70-2021

Public Comment No. 2153-NFPA 70-2021 [Definition: Microgrid System]

Public Comment No. 1505-NFPA 70-2021 [Definition: Microgrid System]

Public Comment No. 1442-NFPA 70-2021 [Definition: Microgrid System]

Second Revision No. 8288-NFPA 70-2021 [Definition: Module.]

PV Module. (Module)

A complete, environmentally protected unit consisting of solar cells and other components designed to produce dc power. ~~(690)~~ (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 14:39:50 EDT 2021

Committee Statement

Committee Statement: For correlation purposes, to group the definition with related terms, and to comply with the requirements of NEC Style Manual Section 2.2.2.5, and Section 2.2.2.3, the base term is updated to PV Module and alternate term (Module) as both terms are referenced in NEC requirements.

In addition, it is recommended that this become a global definition because it is used in more than one article (see Article 600).

Response Message: SR-8288-NFPA 70-2021

Second Revision No. 8259-NFPA 70-2021 [Definition: Photovoltaic (PV) System.]

PV (Photovoltaic) System. (PV System) (Photovoltaic ~~(PV)~~ System.)

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

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 12:35:55 EDT 2021

Committee Statement

Committee Statement: To comply with NEC Style Manual Section 2.2.2.3 the base term is updated to PV (Photovoltaic) System. To comply with NEC Style Manual Section 2.2.2.5. alternate terms (PV System) (Photovoltaic System) are added.

Response Message: SR-8259-NFPA 70-2021

Public Comment No. 1506-NFPA 70-2021 [Definition: Photovoltaic (PV) System.]

Second Revision No. 8264-NFPA 70-2021 [Definition: Power Source Output Circuit.]

Power Source Output ~~Circuit~~ Conductors .

The conductors between power production equipment and the service or other ~~systems~~ premises wiring . (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 12:43:35 EDT 2021

Committee Statement

Committee Statement: Clarifications more accurately describe that this term defines conductors. Adding that their end point is where they connect to service equipment provides clarity where these conductors end when connecting to services. Adding that these conductors can also end where they connect to other premises wiring covers all other cases such as where they connect to circuit breakers in panelboards, existing feeders, or any other equipment including other power source output conductors

Response Message: SR-8264-NFPA 70-2021

Public Comment No. 1917-NFPA 70-2021 [Definition: Power Source Output Circuit.]

Second Revision No. 8279-NFPA 70-2021 [Definition: Rated Power.]

Rated Power.

The output power of a wind turbine at its rated wind speed. (694) (CMP-4)

Informational Note: ~~The method for measuring wind turbine power output is specified in~~ See IEC 61400-12-1, *Power Performance Measurements of Electricity Producing Wind Turbines*, for the method for measuring wind turbine power output .

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 14:02:56 EDT 2021

Committee Statement

Committee Statement: The informational note has been updated to comply with NEC Style Manual Section 4.1.3

Response Message: SR-8279-NFPA 70-2021

Public Comment No. 1510-NFPA 70-2021 [Definition: Rated Power.]

Second Revision No. 8291-NFPA 70-2021 [Definition: Solar Cell.]

Photovoltaic Cell (PV). (Solar Cell) .

The basic ~~PV~~ photovoltaic device that generates dc electricity when exposed to light. (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 14:44:20 EDT 2021

Committee Statement

Committee Statement: This usage of the acronym “PV” is very common across this Code, and its usage is likely to increase in future editions. In several articles, predominantly in Articles 600 and 690, the acronym “PV” is used to augment or modify other terms, without being part of any formal definition. Examples are in 600.34 with the use of common phrase like “PV installation” and “PV panels”, or in other cases such as in 690.11 with “PV arc-fault” and in 690.12 with “PV equipment and circuits”, within common phrases such as “PV modules” and “PV arrays”

This revision adds alternate and clarifying terms to this existing definition without changing the meaning of the definition. Keeping the original term of “solar cell” as an alternate term prevents any correlation issues with this change. The full term and acronym has been added to the definition as permitted in the Style Manual Section 3.2.3.

Response Message: SR-8291-NFPA 70-2021

Second Revision No. 8280-NFPA 70-2021 [Definition: Tower (as applied to wind electric systems).]

Tower ~~(as applied to wind electric systems)~~ .

A pole or other structure that supports a wind turbine. (694) (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 14:06:37 EDT 2021

Committee Statement

Committee Statement: The title of the definition has been updated to comply with NEC Style Manual Section 2.2.2.3.2. The reference to the article number is sufficient to clarify that the definition of tower applies to wind electric system only.

Response Message: SR-8280-NFPA 70-2021

Public Comment No. 1511-NFPA 70-2021 [Definition: Tower (as applied to wind electric systems).]

Second Revision No. 8282-NFPA 70-2021 [Definition: Wind Turbine Output Circuit.]

Wind Turbine Output Circuit. **(Turbine Output Circuit)**

The circuit conductors between the internal components of a wind turbine (which might include an alternator, integrated rectifier, controller, and/or inverter) and other equipment. (694) (CMP-4)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 14:12:11 EDT 2021

Committee Statement

Committee Statement: The term is used within Article 694 alternately as "turbine output circuit", which has been added as an alternate term to the definition per NEC Style Manual Section 2.2.2.5

Response Message: SR-8282-NFPA 70-2021

Public Comment No. 2220-NFPA 70-2021 [Definition: Wind Turbine Output Circuit.]

Second Revision No. 8300-NFPA 70-2021 [Section No. 690.1]

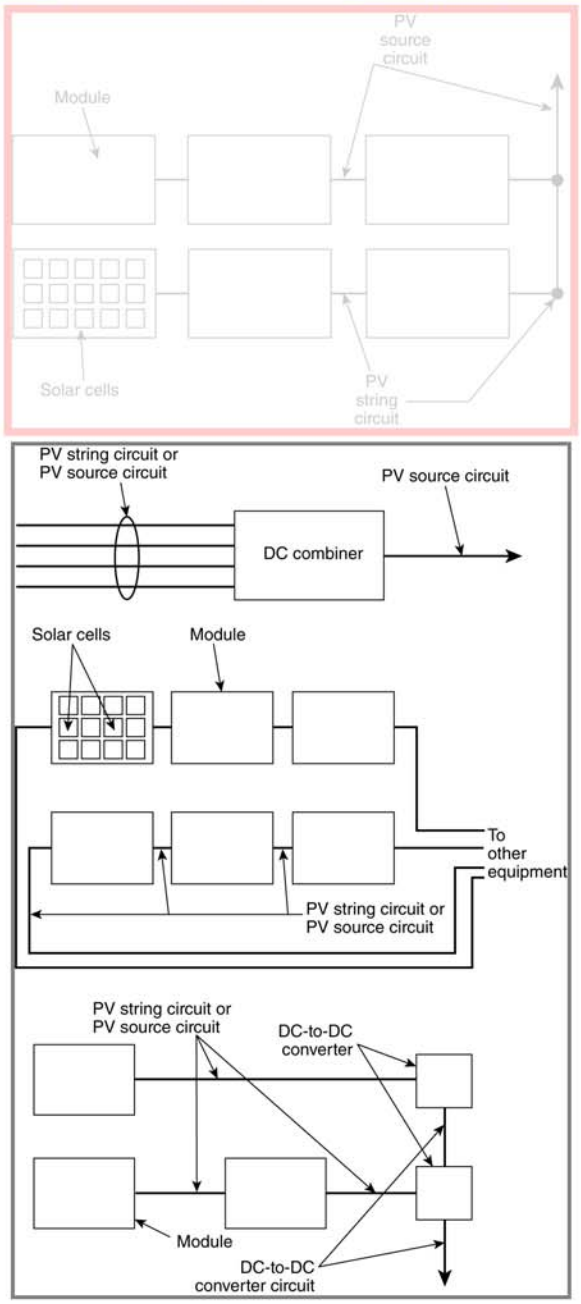
690.1 Scope.

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. The systems covered by this article include those interactive with other electric power production sources or stand-alone, or both. These PV systems may have ac or dc output for utilization.

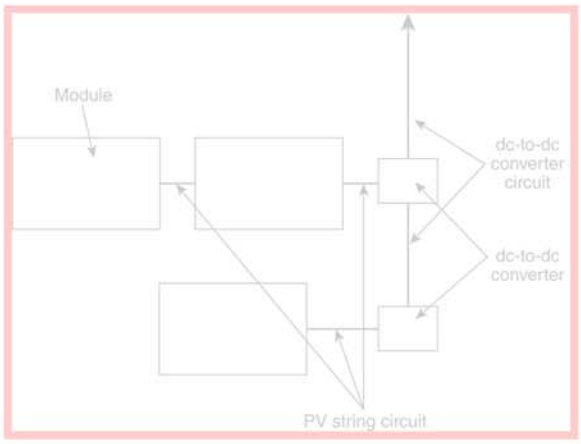
Informational Note No. 1: See Informational Note Figure 690.1~~, Informational Note Figure 690.1(b) , and Informational Note Figure 690.1(c)~~ .

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

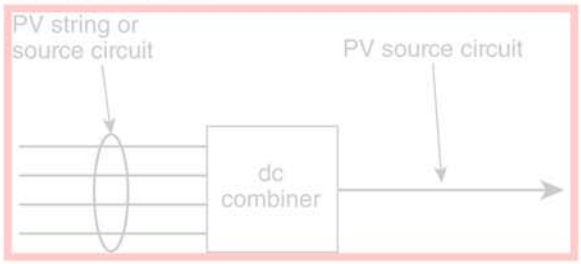
Figure Informational Note Figure 690.1 ~~Identification~~ Illustration of PV System DC Circuits and PV System ~~Common~~ Components in a Typical PV Installation .



~~**Figure Informational Note Figure 690.1(b) Illustration of PV System Components, PV Source Circuit, and dc-to-dc Converter Circuit in a Typical PV Installation.**~~



~~**Figure Informational Note Figure 690.1(c) Illustration of PV Source Circuit and dc Combiner in a Typical PV Installation.**~~



Supplemental Information

File Name	Description	Approved
NEC_CMP_4_SR8300_690.1.docx	For staff use	

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 15:31:12 EDT 2021

Committee Statement

Committee Statement: In Informational Note No.1 revised titles, deleted subheadings, and revised Figure Informational Note 690.1 to comply with NEC Style Manual. Combined three figures (Figures 690.1(a), (b) and (c)) into one figure and retained mention of common components in a typical PV installation.

Response Message: SR-8300-NFPA 70-2021

Public Comment No. 1722-NFPA 70-2021 [Section No. 690.1]

Public Comment No. 839-NFPA 70-2021 [Section No. 690.1]

Public Comment No. 841-NFPA 70-2021 [Section No. 690.1]

Second Revision No. 8312-NFPA 70-2021 [Sections 690.4(A), 690.4(B)]

(A) ~~Photovoltaic~~ PV Systems.

~~Photovoltaic~~ PV systems shall be permitted to supply a building or other structure in addition to any other electrical supply system(s).

(B) Equipment.

Electronic power converters, motor generators, PV modules, ac modules and ac module systems, dc combiners, PV rapid shutdown equipment (PVRSE) , PV hazard control equipment (PVHCE) , PV hazard control systems (PVHCS) , dc circuit controllers, and charge controllers intended for use in PV systems shall be listed or be evaluated for the application and have a field label applied.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 16:16:42 EDT 2021

Committee Statement

Committee Statement: The first use of PV was added to the definition in Article 100. References to photovoltaic in Article 690 have been changed to PV.

Added PV to rapid shut down. Added abbreviation (PVRSE) as first occurrences in Article 690.

Added abbreviation (PVHCS) and (PVHCE) as first occurrences in Article 690.

Response Message: SR-8312-NFPA 70-2021 Abbreviations ac and dc are terms in common use. PV modules, ac modules, ac module systems, and dc combiners are defined terms in Article 100

Public Comment No. 674-NFPA 70-2021 [Section No. 690.4(B)]

Second Revision No. 8311-NFPA 70-2021 [Section No. 690.4(C)]

(C) Qualified Personnel.

The ~~construction and operation~~ installation of equipment, associated wiring, and interconnections shall be performed only by qualified persons.

~~Informational Note: See Article 100 for the definition of *qualified person* .~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 16:11:37 EDT 2021

Committee Statement

Committee Statement: The First Draft text is reverted to the original 2020 text to retain the enforceable term “installation”.

The informational note was deleted to comply with NEC Style Manual Section 3.1.3 since it is not necessary to support or improve the application of this requirement.

Response Message: SR-8311-NFPA 70-2021

Public Comment No. 1583-NFPA 70-2021 [Section No. 690.4(C)]

Public Comment No. 1457-NFPA 70-2021 [Section No. 690.4(C)]

Public Comment No. 676-NFPA 70-2021 [Section No. 690.4(C)]

Second Revision No. 8318-NFPA 70-2021 [Section No. 690.7 [Excluding any Sub-Sections]]

The maximum voltage ~~of PV system dc circuits~~ shall be ~~the highest voltage between any two conductors of a circuit 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. The maximum voltage of PV system dc circuits shall be the highest voltage between any two conductors of a circuit or any conductor and ground and shall comply with the following:

(1) PV system dc circuits are no greater than 1000 volts within or originating from arrays located on or attached to buildings and PV system dc circuits inside buildings ~~shall have a maximum voltage no greater than 1000 volts~~ .

(2) PV system dc circuits are no greater than 600 volts on or in one- and two-family dwellings ~~shall have a maximum voltage no greater than 600 volts~~ .

(3) PV system dc circuits ~~with a maximum voltage~~ greater than 1000 volts shall comply with 690.31(G).

~~PV system dc circuits within or originating from arrays located on or attached to buildings and PV system dc circuits inside buildings shall have a maximum voltage no greater than 1000 volts. PV system dc circuits on or in one- and two-family dwellings shall have a maximum voltage no greater than 600 volts. PV system dc circuits with a maximum voltage greater than 1000 volts shall comply with 690.31(G).~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 16:46:47 EDT 2021

Committee Statement

Committee Statement: First sentence moved to the end of the first paragraph for readability and to set up list. Section is revised to show voltage limit information as a numbered list item format in accordance with NEC Style Manual section Section 2.1.5.4

Language in the third sentence (now second sentence) changed from “used for” to “applied to”.

Response Message: SR-8318-NFPA 70-2021

Public Comment No. 705-NFPA 70-2021 [Section No. 690.7]

Second Revision No. 8322-NFPA 70-2021 [Section No. 690.8(B)]

(B) Conductor Ampacity.

Circuit conductors shall have an ampacity not less than the larger of 690.8(B)(1) or (B)(2) ~~and comply with 110.14(C) for equipment terminations~~ .

(1) Without Adjustment and Correction Factors.

The minimum conductor size with an ampacity not less than the maximum currents calculated in 690.8(A) multiplied by 125 percent.

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) With Adjustment and Correction Factors.

The maximum currents calculated in 690.8(A) with adjustment and correction factors.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 16:56:47 EDT 2021

Committee Statement

Committee Statement: Reference to 110.14 is unnecessary and is removed for compliance with Section 4.1.1 of the NEC Style Manual.

Response Message: SR-8322-NFPA 70-2021

Public Comment No. 677-NFPA 70-2021 [Section No. 690.8(B)]

Second Revision No. 8324-NFPA 70-2021 [Section No. 690.8(D)]

(D) Multiple PV String Circuits.

Where an overcurrent device is used to protect more than one set of parallel-connected PV string circuits, the ampacity of each conductor protected by the device shall not be less than the ~~rating of the overcurrent device plus the sum of the maximum currents as calculated in 690.8(A)(1)(a) of the other parallel-connected PV string circuits protected by the overcurrent devices.~~ sum of the following:

(1) The rating of the overcurrent device

(2) The sum of the maximum currents as calculated in 690.8(A)(1)(a) ~~of~~ for the other parallel-connected PV string circuits protected by the overcurrent devices~~s~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 17:00:48 EDT 2021

Committee Statement

Committee Statement: The long sentence in 690.8(D) is split into two items of a list to improve readability

Response Message: SR-8324-NFPA 70-2021

Public Comment No. 678-NFPA 70-2021 [Section No. 690.8(D)]

Second Revision No. 8326-NFPA 70-2021 [Section No. 690.9(D)]

(D) ~~Power~~ Transformers.

Overcurrent protection for power transformers shall be installed in accordance with ~~705.30(C)~~ 705.30(F) .

Exception: A power transformer with a current rating on the side connected toward the interactive inverter output, not less than the rated continuous output current of the inverter, shall be permitted without overcurrent protection from the inverter.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 17:05:43 EDT 2021

Committee Statement

Committee Statement: Removed “Power” from title for consistency with change to 705.30(C) and fixed section reference.

Response Message: SR-8326-NFPA 70-2021

Public Comment No. 708-NFPA 70-2021 [Section No. 690.9(D)]

Second Revision No. 8431-NFPA 70-2021 [Section No. 690.11]

690.11 Arc-Fault Circuit Protection (~~Direct Current~~ dc).

Photovoltaic systems with PV system dc circuits 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 system dc circuits that ~~are installed in metal raceways or~~ utilize metal-clad cables, ~~or~~ are installed in metal raceways or enclosed metal cable trays, or are underground shall be permitted without arc-fault circuit protection~~. Detached structures whose sole purpose is to support or contain PV system equipment shall not be considered buildings according to this exception.~~ if the installation complies with at least one of the following:

(1) The PV system dc circuits are not installed in or on buildings.

(2) The PV system dc circuits are located in or on detached structures whose sole purpose is to support or contain PV system equipment.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 15:14:08 EDT 2021

Committee Statement

Committee Statement: Changed Direct Current to DC for compliance with NEC Style Manual.

The informational note is deleted based on the fact that this note is no longer needed for the purposes of applying the requirements in this section.

The language of the exception is revised to avoid an unintended determination of what is considered a building. A list format is used in accordance with Section 2.1.5.1 of the NEC Style Manual.

Response Message: SR-8431-NFPA 70-2021

Public Comment No. 679-NFPA 70-2021 [Section No. 690.11]

Public Comment No. 2032-NFPA 70-2021 [Section No. 690.11]

Second Revision No. 8328-NFPA 70-2021 [Section No. 690.12(B)(2)]

(2) Inside the Array Boundary.

The PV system shall comply with one of the following:

(1) The PV system shall provide shock hazard control for firefighters through the use of ~~a PV hazard control system (PVHC) installed~~ a PVHCS installed in accordance with the instructions included with the listing or field labeling. Where a ~~hazard control system~~ PVHCS requires initiation to transition to a controlled state, the rapid shutdown initiation device required in 690.12(C) shall perform this initiation.

Informational Note No. 1: A listed or field-labeled ~~hazard PV hazard control system~~ PVHCS is 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~~ firefighters . See UL 3741, *Photovoltaic Hazard Control*.

(2) The PV system shall provide shock hazard control for firefighters by limiting the highest voltage inside equipment or between any two conductors of a circuit or any conductor and ground inside array boundary to not more than 80 volts within 30 seconds of rapid shutdown initiation.

Informational Note No. 2: Common methods include the use of PV equipment with a limited maximum voltage of 80 volts as determined by 690.7, ~~PV rapid shutdown equipment (~~ PVRSE~~)~~ , ~~PV hazard control equipment (~~ PVHCE~~)~~ , or any combination of these.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 17:11:45 EDT 2021

Committee Statement

Committee Statement: Implemented acronyms PVRSE, PVHCS and PVHCE throughout section

Response Message: SR-8328-NFPA 70-2021

Public Comment No. 680-NFPA 70-2021 [Section No. 690.12(B)(2)]

Second Revision No. 8332-NFPA 70-2021 [Section No. 690.12(C)]

(C) Initiation Device.

Where circuits identified in 690.12(A) are required to meet the requirements in 690.12(B), an initiation device(s) shall be provided and shall initiate the rapid shutdown function. 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-and two-family dwellings, an initiation device(s), where required, shall be located at a readily accessible outdoor location ~~outside the building~~ .

For a single PV system, the rapid shutdown initiation shall occur by the operation of any single initiation device. Devices shall consist of at least one or more 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: Examples of where an initiation device that complies with 690.12(C)(3) would be used is where a PV system is connected to an optional standby or stand-alone system.~~

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.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 17:23:24 EDT 2021

Committee Statement

Committee Statement: Language regarding outdoor location is harmonized with language in Article 230.

The informational note was removed as it is no longer necessary and does not improve clarity.

Response Message: SR-8332-NFPA 70-2021

Second Revision No. 8333-NFPA 70-2021 [Section No. 690.15(A)]

(A) Type of Disconnecting Means.

Where a disconnect is required to isolate equipment, the disconnecting means shall be one of the following:

(1) An equipment disconnecting means in accordance with 690.15(C)

(2) An isolating device as part of listed equipment where ~~ability to operate the isolating device is restricted to conditions where there is no current flow through the device through~~ an interlock or similar means prevents the opening of the isolating device under load

(3) For circuits with a maximum circuit current of 30 amperes or less, an isolating device in accordance with 690.15(B)

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 17:26:14 EDT 2021

Committee Statement

Committee Statement: Item 2 in 690.15(A) is edited for readability.

Response Message: SR-8333-NFPA 70-2021

Public Comment No. 2141-NFPA 70-2021 [Section No. 690.15(A)]

Second Revision No. 8336-NFPA 70-2021 [Section No. 690.31(C)(1)]

(1) Single-Conductor Cable.

Single-conductor cables shall comply with 690.31(C)(1)(a) through (C)(1)(~~d~~ c).

(a) Single-conductor cable in exposed outdoor locations in PV system dc circuits within the PV array shall be permitted to be one of the following:

(1) PV wire or cable

(2) Single-conductor cable marked sunlight resistant and Type USE-2 and Type RHW-2

(b) Exposed cables sized 8 AWG or smaller 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 or cable shall be permitted in all locations where RHW-2 is permitted.

Exception: PV systems meeting the requirements of 691.4 shall be permitted to have support and securement intervals as defined in the engineered design.

(c) Exposed cables sized larger than 8 AWG shall be supported and secured at intervals not to exceed 1400 mm (54 in.) by cable ties, straps, hangers, or similar fittings listed and identified for securement and support in ourtdoor locations.

(c) ~~PV wire or cable shall be permitted in all locations where RHW-2 is permitted.~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 17:33:18 EDT 2021

Committee Statement

Committee Statement: Redundant language with Item (d) is removed.

Response Message: SR-8336-NFPA 70-2021

Public Comment No. 2035-NFPA 70-2021 [Section No. 690.31(C)(1)]

Second Revision No. 8343-NFPA 70-2021 [Section No. 690.31(D)(1)]

(1) Metal Raceways and Enclosures.

Where inside buildings, PV system dc circuits that exceed 30 volts or 8 amperes shall be contained in metal raceways, in Type MC metal-clad cable that complies with 250.118(A)(10)(b) or (A)(10)(c), or in metal enclosures.

Exception: ~~PV hazard control systems~~ PVHCS installed in accordance with 690.12(B)(2)(1) shall be permitted to be provided with or listed for use with nonmetallic enclosure(s), nonmetallic raceway(s), and cables 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~~ .

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 17:47:13 EDT 2021

Committee Statement

Committee Statement: This revision implements the acronym PVHCS and removes the last six words of the exception as it is an undefined phrase.

Response Message: SR-8343-NFPA 70-2021

Second Revision No. 8338-NFPA 70-2021 [Section No. 690.31(G)]

(G) Over 1000 Volts DC.

Equipment and wiring methods containing PV system dc circuits with a maximum voltage greater than 1000 volts shall comply with the following:

(1) Shall not be permitted on or in one- and two-family dwellings.

(2) Shall not be permitted within buildings containing habitable rooms.

(2) ~~Where suitable for use in PV systems, equipment containing PV system dc circuits with a maximum voltage no greater than 1500 volts shall not be required to comply with Parts II and III of Article 490.~~

(3) Where installed on the exterior of buildings shall be located less than 3 m (10 ft) above grade. Wiring methods containing PV system dc circuits connected to this equipment shall not be permitted to attach to the building greater than 10 m (33 ft) along the building surface from the equipment.

(3) ~~Where accessible to unqualified persons, the installation shall comply with 110.31(C)(1) and 110.31(D).~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 17:36:08 EDT 2021

Committee Statement

Committee Statement: The new Articles 305 and 495 cover wiring greater than 1500 Vdc so List Item (3) is redundant and is removed. List item #5 is simply a pointer so this item is removed.

Response Message: SR-8338-NFPA 70-2021

Public Comment No. 2053-NFPA 70-2021 [Section No. 690.31(G)]

Second Revision No. 8344-NFPA 70-2021 [Section No. 690.41]

690.41 PV System DC Circuit Grounding and Protection.

(A) PV System DC Circuit Grounding Configurations.

One or more of the following system configurations shall be employed for PV system dc circuits:

(1) 2-wire circuits with one functionally grounded conductor

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

(3) Circuits not isolated from the grounded inverter output circuit

(4) Ungrounded circuits

(5) Solidly grounded circuits as permitted in 690.41(B)

(6) Circuits protected by equipment listed and identified for the use

(B) DC Ground-Fault ~~Protection~~ Detector-Interrupter (GFDI) Protection .

PV system dc circuits that exceed 30 volts or 8 amperes shall be provided with ~~dc ground-fault~~ GFDI protection meeting the requirements of 690.41(B)(1) and (B)(2) to reduce fire hazards.

Solidly grounded PV source circuits with not more than two modules in parallel and not on or in buildings shall be permitted without ~~ground-fault~~ GFDI protection.

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

(1) Ground-Fault Detection.

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

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

(2) Faulted Circuits.

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

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

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

(3) Indication of Faults.

~~Ground-fault~~ The GFDI protection equipment shall provide indication of ground faults at a readily accessible location.

Informational Note: Examples of indication include, but are 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

Committee: NEC-P04

Submittal Date: Mon Oct 25 17:49:48 EDT 2021

Committee Statement

Committee Statement: This section has been edited for consistency with the new GFDI definition in Article 100 to prevent confusion over the general use of the term “ground-fault protection” or GFCI.

Response Message: SR-8344-NFPA 70-2021

Public Comment No. 559-NFPA 70-2021 [Section No. 690.41]

Second Revision No. 8349-NFPA 70-2021 [Section No. 690.42]

690.42 Point of PV System DC Circuit Grounding Connection.

(A) Circuits with ~~Ground-Fault~~ GFDI Protection.

Circuits protected by ~~a ground-fault protective device~~ GFDI equipment in accordance with 690.41(B) shall have any circuit-to-ground connection made by the ~~ground-fault protective device~~ GFDI equipment .

(B) Solidly Grounded Circuits.

For solidly grounded PV system dc circuits, the grounding connection shall be made from any single point on the PV dc system to a point in the grounding electrode system in 690.47(A).

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 18:19:19 EDT 2021

Committee Statement

Committee Statement: This section has been edited for consistency with the new GFDI definition in Article 100 to prevent confusion over the general use of the term “ground-fault protection” or GFCI.

The term device was changed to equipment to more accurately describe the options which comply with this requirement.

Response Message: SR-8349-NFPA 70-2021

Second Revision No. 8635-NFPA 70-2021 [Section No. 690.47(B)]

(B) Grounding Electrodes and Grounding Electrode Conductors.

~~Grounding~~ Additional grounding electrodes shall be permitted to be installed in accordance with ~~Part III of Article 250 shall be utilized for PV systems. A grounding electrode conductor shall be sized according to~~ ~~250.66~~ 250.52 and 250.54 . Grounding electrodes shall be permitted to be connected directly to the PV module frame(s) or support structure. ~~Arrays~~ A grounding electrode conductor shall be sized according to 250.66 . A support structure for a ground-mounted PV array shall be permitted to be considered a grounding electrode if it meets the requirements of 250.52 . PV arrays mounted to buildings shall be permitted to use the metal structural frame of the building if the requirements of 250.68(C)(2) are met.

~~**(1)** Support Structures.~~

~~PV system support structures designed and tested under engineering supervision and showing comparable resistance to earth as the structures described in 250.52(A)(2) shall be permitted to be considered grounding electrodes.~~

~~Informational Note: See IEEE 81-2012, *IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System* , for test methods and techniques used for measuring earth resistance.~~

~~**(1)** Auxiliary Electrodes.~~

~~Additional grounding electrodes, including the structural support members as described in 690.47(B)(1), shall be permitted to be installed in accordance with 250.54.~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Fri Oct 29 12:20:15 EDT 2021

Committee Statement

Committee Statement: At the request of the Correlating Committee task group on this subject, the language is reverted to the 2020 edition language. The Correlating Committee will be establishing a task group to address this issue for the 2026 edition.

Response Message: SR-8635-NFPA 70-2021

Public Comment No. 711-NFPA 70-2021 [Section No. 690.47]

Second Revision No. 8351-NFPA 70-2021 [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 persons.

Informational Note No. 1: Refer to NFPA *70E*-2021, *Standard for Electrical Safety in the Workplace*, for electrical safety requirements.

(2) Access to PV electric supply stations shall be restricted 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.

(6) The station ~~is~~ shall be monitored from a central command center.

(7) The station ~~has~~ shall have an inverter generating capacity of at least 5000 kW.

Informational Note No. 2: Some individual sites with capacities ~~between 2000 kW and~~ less than 5000 kW are operated as part of a group of facilities with a total generating capacity of ~~well over~~ much greater than 5000 kW.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 18:37:49 EDT 2021

Committee Statement

Committee Statement: The information note was changed for improved readability and to remove the lower threshold of 2000 kW,

Response Message: SR-8351-NFPA 70-2021 The size threshold of 5000 kW is a practical limit which is unchanged from previous editions.

Public Comment No. 2152-NFPA 70-2021 [Section No. 691.4]

Public Comment No. 1978-NFPA 70-2021 [Section No. 691.4]

Second Revision No. 8352-NFPA 70-2021 [Sections 694.7(A), 694.7(B)]

(A) Wind Electric Systems.

A wind electric system(s) shall be permitted to supply a building or other structure in addition to other sources of supply. These requirements apply to both onshore and offshore installations.

(B) Equipment.

Wind electric systems shall ~~be approved for the application and installation location (onshore or offshore) in accordance~~ comply with one of the following:

(1) Be listed

(2) Be evaluated for the application and have a field label applied

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: See UL 6141, *Standard for Wind Turbines Permitting Entry of Personnel*, and UL 6142, *Standard for Small Wind Turbine Systems*, for further information on wind turbine equipment. Ratings for wind turbines could include limitations on installation locations such as onshore or offshore. Testing is typically performed under supervision of a qualified electrical testing organization.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Mon Oct 25 18:47:21 EDT 2021

Committee Statement

Committee Statement: New text in 694.7(A) and in the informational note to (B) address the locations where these system are installed.

Some text in 694.7(B) is removed as it is redundant with general requirements in Article 110.

Response Message: SR-8352-NFPA 70-2021

Public Comment No. 717-NFPA 70-2021 [Section No. 694.7(B)]

Second Revision No. 8359-NFPA 70-2021 [Section No. 705.1]

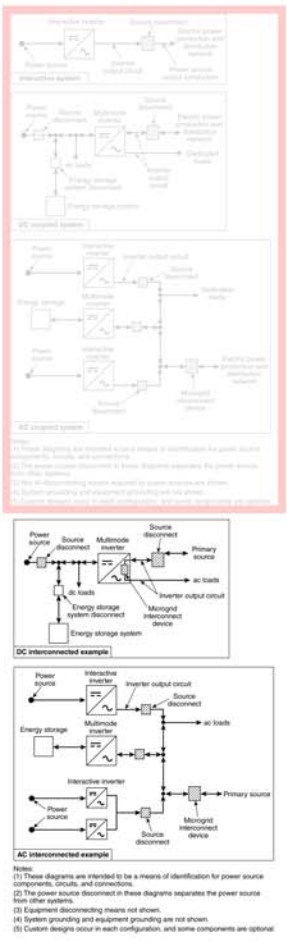
705.1 Scope.

This article covers installation of one or more electric power production sources operating in parallel with a primary source(s) of electricity.

Informational Note No. 1: Examples of the types of primary sources include a utility supply or an on-site electric power source(s).

Informational Note No. 2: See ~~Informational Note Figure 705.2~~ Informational Note Figure 705.1 .

Figure Informational Note Figure 705.1 Identification of Power Source Components in Common Configurations



Supplemental Information

File Name	Description	Approved
NEC_CMP4_SR8359_705.1_Figure705.2.docx	For staff use	

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 10:11:55 EDT 2021

Committee Statement

Committee Statement: Figures and titles have been modified to provide improved clarity and to align with terms used in Article 705.

Response Message: SR-8359-NFPA 70-2021

Public Comment No. 1455-NFPA 70-2021 [Section No. 705.1]

Public Comment No. 1471-NFPA 70-2021 [Section No. 705.1]

Second Revision No. 8361-NFPA 70-2021 [Section No. 705.3]

~~**705.3** Other Articles.~~

~~Where interconnected electric power production sources are used to provide power for compliance with the articles listed in Table 705.3, any supplemental or modifying requirements in the articles listed in Table 705.3 shall apply.~~

~~Table 705.3 Other Articles~~

~~Equipment/Occupancy~~	~~Article~~
~~Health care facilities~~	~~517~~
~~Fire pumps~~	~~695~~
~~Emergency systems~~	~~700~~
~~Legally required standby systems~~	~~701~~
~~Critical operations power systems (COPS)~~	~~708~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 10:25:27 EDT 2021

Committee Statement

Committee Statement: This section with included table is removed as it is unnecessary to apply this article, and related articles' requirements. Section 90.3 provides sufficient guidance to a user of this Code.

Response Message: SR-8361-NFPA 70-2021

Public Comment No. 125-NFPA 70-2021 [Section No. 705.3]

Public Comment No. 683-NFPA 70-2021 [Section No. 705.3]

Public Comment No. 2059-NFPA 70-2021 [Section No. 705.3]

Second Revision No. 8363-NFPA 70-2021 [Section No. 705.6]

705.6 Equipment Approval.

Interconnection and interactive equipment ~~including, but not limited to, microgrid interconnect devices, power control systems, interactive inverters, engine generators, energy storage equipment, and wind turbines,~~ intended to connect to or operate in parallel with power production sources~~,~~ shall be listed for the required interactive function or be evaluated for the interactive function and have a field label applied, or both.

Informational Note No. 1: See UL 1741, *Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources*, for evaluating interconnected equipment. Sources identified as stand-alone, interactive, or multimode are specifically identified and certified to operate in these operational modes. Stand-alone sources operate in island mode, interactive sources operate in interactive mode, and multimode sources operate in either island mode or interactive mode. Stand-alone sources are not evaluated for interactive capabilities.

Informational Note No. 2: An interactive function is common in equipment such as microgrid interconnect devices, power control systems, interactive inverters, synchronous engine generators, ac energy storage systems, and ac wind turbines.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 10:28:34 EDT 2021

Committee Statement

Committee Statement: The list of equipment examples, which is not complete nor mandatory, has been moved to a new informational note to simplify and clarify the mandatory requirement text.

Response Message: SR-8363-NFPA 70-2021

Public Comment No. 684-NFPA 70-2021 [Section No. 705.6]

Second Revision No. 8375-NFPA 70-2021 [Section No. 705.11]

705.11 Source Connections to a Service.

~~An electric power production source shall be permitted to be connected to an additional service in accordance with 230.2(A). An electric power production source shall be permitted to be connected to the supply side of the service disconnecting means in accordance with 230.82(6) and shall comply with 705.11(A) through (E).~~

(A) Service Connections.

An electric power production source shall be permitted to be connected to a service by one of the following methods:

(1) To a new service in accordance with 230.2(A)

(2) To the supply side of the service disconnecting means in accordance with 230.82 (6)

(3) To an additional set of service entrance conductors in accordance with 230.40 , Exception No. 5

These connections shall comply with 705.11(B) through (F).

(B) Conductors.

Service conductors connected to power production sources shall comply with the following:

(1) The ampacity of the service conductors connected to the power production source service disconnecting means shall not be less than the sum of the power production source maximum circuit current in 705.28(A) .

(2) The service conductors connected to the power production source service disconnecting means shall be sized in accordance with 705.28 and not be smaller than 6 AWG copper or 4 AWG aluminum or copper-clad aluminum.

(3) The ampacity of any other service conductors to which the power production sources are connected shall not be less than that required in 705.11(B) .

~~**(1)** Service Conductors.~~

~~The sum of the power source continuous current output ratings not controlled by a power control system (PCS) in 705.13 plus the settings of PCS-controlled power source current in 705.13(B) shall not exceed the ampacity of the service conductors to which the power source output conductors are connected.~~

~~Informational Note: See Article 100 for the definition of *service conductors* .~~

~~**(1)** Power Source Output Conductors.~~

~~The conductors from the point of connection with the service conductors to the power source disconnecting means shall comply with the following:~~

(0) ~~Be sized in accordance with 705.28 and not smaller than 6 AWG copper or 4 AWG aluminum or copper-clad aluminum~~

(0) ~~Be installed in accordance with 230.30 or 230.43~~

(C) Connections.

Connections to service conductors or equipment shall comply with 705.11(B) (1) through (B)(3).

(1) Splices or Taps.

~~The connection of conductors from the power source disconnecting means spliced or tapped to service~~ Service conductor~~s~~ splices and taps shall be made in accordance with 230.33 or 230.46 and comply with all applicable enclosure fill requirements.

(2) Existing Equipment.

Any modifications to existing equipment shall be made in accordance with the manufacturer's instructions, or the modification must be field evaluated for the application and be field labeled.

(3) Utility-Controlled Equipment.

For meter socket enclosures or other equipment under the exclusive control of the electric utility, only connections approved by the electric utility shall be permitted.

(D) ~~Power Source~~ Service Disconnecting Means.

A disconnecting means in accordance with ~~705.20~~ Parts VI through VIII of Article 230 shall be provided to disconnect all ~~undergrounded~~ ungrounded conductors of ~~an electric~~ a power production source ~~from a service and shall meet the requirements in 705.11(C)(1) and (C)(2)~~ from the conductors of other systems .

~~**(1)** Location.~~

~~The power source disconnecting means shall be located in accordance with 230.70(A) and all other applicable requirements of Part VI of Article 230.~~

~~**(1)** Additional Disconnecting Means.~~

~~Where service entrance conductors are connected to the supply side of the normal service disconnecting means in accordance with 230.40, Exception No. 5, an additional disconnecting means shall be permitted for each interconnected power production source.~~

(E) Bonding and Grounding.

All metal enclosures, metal wiring methods, and metal parts associated with the ~~power source output conductors in 705.11(B)~~ service connected to a power production source shall be bonded in accordance with ~~250.92(B)~~ Parts II through V and VIII of Article 250 . ~~This metal 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 source uses 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.~~

~~**(1)** 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 using a separate bonding conductor sized in accordance with 250.102 based on the size of the power source output circuit conductors.~~

(F) Overcurrent Protection.

The ~~conductors from the point of connection to the~~ power production source service conductors ~~to the power source disconnecting means~~ shall be protected from overcurrent in accordance with Part VII of Article 230. ~~Ground~~ The rating of the overcurrent protection device of the power production source service disconnecting means shall be used to determine if ground -fault protection of equipment is required in accordance with 230.95~~shall be based on the rating of the power source and shall be applied at the power source disconnecting means where required~~ .

Supplemental Information

File Name	Description	Approved
NEC_CMP4_SR_8375_705.11.1635263666139.docx	Staff Use	

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 11:49:27 EDT 2021

Committee Statement

Committee Statement: Revisions were made to this section to clarify the first revision text, better align this section with related requirements in other articles, and to comply with the NEC Style Manual. Change to this section are as follows:

1. The power production source disconnecting means located between the service point and the power production source are clarified to be service disconnects. New Part (A) is reworded to best describe the service connections.

2. Sections 705.11(B) and 705.11 (C) (formerly parts (A) and (B)) have been edited to clarify that the conductors on the line side of the power source service disconnecting means are service conductors. Previous text is revised to align with the activities of the Correlating Committee task group on EMS and the related changes to include energy management systems in 705.28(A).

3. Sections 705.11(D) and 705.11(E) (formerly parts (C) and (D)) have been edited to eliminate redundancy within this Code. In this instance users are directed to Articles 230 and 250.

4. Section 705.11(F) (formerly part (E)) has been modified to clarify how a code user is to determine the rating to be used to determine if 230.95 applies.

Response Message: SR-8375-NFPA 70-2021

Public Comment No. 165-NFPA 70-2021 [Section No. 705.11(D)]

Public Comment No. 1098-NFPA 70-2021 [Section No. 705.11]

Public Comment No. 685-NFPA 70-2021 [Section No. 705.11]

Public Comment No. 164-NFPA 70-2021 [Section No. 705.11(C)]

Public Comment No. 1052-NFPA 70-2021 [Section No. 705.11(A)(1)]

Second Revision No. 8364-NFPA 70-2021 [Section No. 705.12 [Excluding any Sub-Sections]]

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 or feeders are fed simultaneously by a primary source of electricity and one or more other power source(s), the feeders or distribution equipment shall comply with relevant sections of 705.12(A) and (B). Currents from power source connections to feeders or busbars shall be based on the maximum circuit currents calculated in 705.28(A). ~~Where a power control system (PCS) is installed in accordance with 705.13 , the setting of the PCS controller shall be the power source output circuit current from the controlled power sources.~~ The ampacity of feeders and taps shall comply with 705.12(A), and the ampere ratings of busbars shall comply with 705.12(B).

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 10:37:25 EDT 2021

Committee Statement

Committee Statement: This sentence is deleted as redundant based on the changes made to 705.28(A)

Response Message: SR-8364-NFPA 70-2021

Public Comment No. 1053-NFPA 70-2021 [Section No. 705.12 [Excluding any Sub-Sections]]

Second Revision No. 8366-NFPA 70-2021 [Section No. 705.13]

705.13 ~~Power Control~~ Energy Management Systems (EMS) .

~~A power control system (PCS) shall be listed and evaluated to control the output of one or more power production sources, energy storage systems (ESS), energy management systems, and other equipment. The PCS shall limit current and loading on the busbars and conductors supplied by the PCS~~ An EMS in accordance with 705.30 shall be permitted to limit current and loading on the busbars and conductors supplied by the output of one or more interconnected electric power production or energy storage sources .

Informational Note: A listed power control system (PCS) is a type of EMS that is capable of monitoring multiple power sources and controlling the current on busbars and conductors to prevent overloading. See UL 1741, *Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources* , and UL 916, *Energy Management Equipment,* for information on PCS and EMS.

~~For the circuits connected to a PCS, the PCS shall limit the current to the ampacity of the conductors or the ampere ratings of the busbars to which it is connected in accordance with 705.13(A) through (E).~~

~~**(A)** Monitoring.~~

~~The PCS controller shall monitor all currents within the PCS. Any busbar or conductor on the load side of the service disconnecting means that is not monitored by the PCS shall comply with 705.12 . Where the PCS is connected in accordance with 705.11 , the PCS shall monitor the service conductors and prevent overload of these conductors.~~

~~**(B)** Settings.~~

~~The sum of all PCS-controlled currents plus all monitored currents from other sources of supply shall not exceed the rating of any busbar or the ampacity of any conductor supplied by the power production sources. Where the PCS is connected to an overcurrent device protecting any busbar or conductor not monitored by the PCS, the setting of the PCS controller shall be set within the ratings of that overcurrent device.~~

~~**(C)** Overcurrent Protection.~~

~~The PCS shall provide overcurrent protection either by overcurrent devices or by the PCS including the functionality as an overcurrent device in the product listing.~~

~~Informational Note: Some PCSs are listed to provide overcurrent protection.~~

~~**(D)** Single Power Source Rating.~~

~~The rating of the overcurrent device for any single power source controlled by the PCS shall not exceed the rating of the busbar or the ampacity of the conductors to which it is connected.~~

~~**(E)** Access to Settings.~~

~~The access to settings of the PCS shall be restricted to qualified personnel in accordance with 240.6(C) .~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 10:43:51 EDT 2021

Committee Statement

Committee Statement: This revision to 705.13 replaces requirements that have now been made redundant through the revisions made to 750.30. Systems covered under 705.13 can perform multiple functions for control of sources and loads. EMS is a more accurate term for those functions. The informational note clarifies that listed PCS are a subset of EMS with specific functionality directed to interconnected power sources.

Response Message: SR-8366-NFPA 70-2021

Public Comment No. 1043-NFPA 70-2021 [Section No. 705.13]

Public Comment No. 687-NFPA 70-2021 [Section No. 705.13]

Second Revision No. 8376-NFPA 70-2021 [Section No. 705.14]

705.5 ~~Output Characteristics~~ Parallel Operation .

~~The output of a power production source operating in parallel with a primary source of electricity shall be compatible with the primary power source output power including the voltage, wave shape, and frequency of the primary source.~~

(A) ~~Marking~~ Output Compatibility .

~~Each power source shall be marked with the rated output current and the nominal operating voltage at a readily visible location~~ Power production sources operating in parallel with a primary source of electricity or other power production sources shall have compatible voltage, wave shape, and frequency ratings .

(B) Synchronous Generators.

Synchronous generators operating in parallel with a primary power source shall be installed with the required synchronizing equipment.

Informational Note: See IEEE 1547, *Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces,* and UL 1741, *Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources,* for utility interconnection.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 12:11:00 EDT 2021

Committee Statement

Committee Statement: Section 705.14 is moved to 705.5 to improve ease of use on this article. Previous Section 705.14(A) was removed as it is redundant and may conflict with product listing requirements and requirements in other power source articles. New second level subdivision (A) and title “Output Compatibility” are added to improve organization of section. Added the term “ratings” to clarify how a user would verify these requirements are met at the time of installation.

Response Message: SR-8376-NFPA 70-2021

Public Comment No. 691-NFPA 70-2021 [Section No. 705.14]

Second Revision No. 8378-NFPA 70-2021 [Section No. 705.20]

705.20 Source Disconnecting Means.

Means shall be provided to disconnect power source output ~~circuit~~ conductors of electric power production equipment from conductors of other systems. ~~Specific source disconnecting means required elsewhere in this *Code* that comply with 705.20 shall be permitted to meet this requirement.~~ A single disconnecting means in accordance with 705.20 shall be permitted to disconnect multiple power sources from conductors of other systems.

Informational Note: See 480.7, Article 445 Part II, Article 690 Part III, Article 692 Part III, Article 694 Part III, and Article 706 Part II for specific source disconnecting means requirements.

The disconnecting means shall comply with the following:

(1) Be one of the following types:

a. A manually operable switch or circuit breaker

b. A load-break-rated pull-out switch

c. A power-operated or remote-controlled switch or circuit breaker that is manually operable locally and opens automatically when control power is interrupted

d. A device listed or approved for the intended application

(2) Simultaneously disconnect all ungrounded conductors of the circuit

(3) Located where readily accessible

(4) Externally operable without exposed live parts

(4) ~~Enclosures with doors or hinged covers containing exposed energized parts when the door or cover is open that require a tool to open or are locked where readily accessible to unqualified persons~~

(5) Plainly indicate whether in the open (off) or closed (on) position

(6) Have ratings sufficient for the maximum circuit current, available fault current, and voltage that is available at the terminals

(7) Where the line and load terminals are capable of being energized in the open position, be marked with the following words or equivalent:

WARNING

ELECTRIC SHOCK HAZARD TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.

Informational Note: With interconnected power sources, some equipment, including switches and fuses, is capable of being energized from both directions.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 12:15:48 EDT 2021

Committee Statement

Committee Statement: The term “circuit” has been removed to align this phrase with its definition. The second sentence has been removed as redundant and not required to enforce the requirements within this section.

List item #5 is removed as redundant with new general requirements located in Section 404.30.

Response Message: SR-8378-NFPA 70-2021 RESPONSE TO PC 692: While requirements for disconnecting means contained in other articles may meet the requirements within this section, CMP-4 the Panel retains the majority of list items contained in 705.20 to address situations where the requirements for disconnecting means from power source systems are either not addressed, or do not meet these minimum requirements.

Public Comment No. 692-NFPA 70-2021 [Section No. 705.20]

Public Comment No. 1472-NFPA 70-2021 [Section No. 705.20]

Second Revision No. 8383-NFPA 70-2021 [Section No. 705.25]

705.25 Wiring Methods.

Power source output ~~circuit~~ conductors shall comply with 705.25(A) through (C).

(A) General.

~~In addition to wiring methods included in Chapter 3 of this~~ *Code* ~~, wiring~~ Wiring methods and fittings ~~specifically~~ listed ~~and identified~~ for use with power production systems ~~and equipment~~ shall be permitted in addition to general wiring methods and fittings permitted elsewhere in this *Code* .

(B) Flexible Cords and Cables.

Flexible cords and cables, where used to connect the moving parts of ~~a~~ power production ~~system~~ equipment, 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~~ or other cable~~, hard service cord, or portable power cable, shall be~~ suitable for extra~~-hard usage, shall be listed for outdoor~~ hard 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*, and UL 9703, *Outline of Investigation for Distributed Generation Wiring Harnesses* , for additional information on DG cable (distributed generation cable) and harnesses . An ac module harness is one example of a multiconductor cable assembly.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 12:27:05 EDT 2021

Committee Statement

Committee Statement: The text is modified to clarify the allowance for different wiring methods. The sentence is rephrased to be more consistent with other Code requirements. The text referring to Article 400 and 110.14 is redundant and was removed in compliance with Section 4.1.1 of the NEC Style Manual. The list of suitable cords and cables has been simplified to allow any evaluated for extra-hard use. Additional statements addressing environmental ratings have also been removed as being redundant with general requirements such as those in Section 110.3.

Response Message: SR-8383-NFPA 70-2021

Public Comment No. 693-NFPA 70-2021 [Section No. 705.25]

Second Revision No. 8388-NFPA 70-2021 [Section No. 705.28]

705.28 Circuit Sizing and Current.

(A) ~~Calculation of~~ Power Source Output Maximum ~~Circuit~~ Current.

Where not elsewhere required or permitted in this *Code*, the maximum current for ~~the~~ power ~~source output circuit shall be the continuous output current rating at the circuit nominal system voltage of the power production equipment.~~ sources shall be calculated using one of the following methods:

(1) The sum of the continuous output current ratings of the power production equipment at the circuit nominal system voltage

(2) For power production equipment controlled by an EMS, the current setpoint of the EMS

(3) Where sources controlled by an EMS are combined with other sources on the same power source output circuit, the sum of 705.28(A)(1) and (A)(2)

(B) Conductor Ampacity.

Where not elsewhere required or permitted in this *Code*, the power source output ~~circuit~~ conductors shall have an ampacity not less than the larger of the following and comply with 110.14(C):

(1) The maximum currents in 705.28(A) multiplied by 125 percent without adjustment or correction factors

Exception No. 1: If the assembly, including the overcurrent devices protecting the circuit, is listed for operation at 100 percent of its rating, the ampacity of the conductors shall be permitted to be not less than the calculated maximum current of 705.28(A).

Exception No. 2: Where a portion of a circuit is connected at both its supply and load ends to separately installed pressure connections as covered in 110.14(C)(2), it shall be permitted to have an ampacity not less than the calculated maximum current of 705.28(A). No portion of the circuit installed under this exception shall extend into an enclosure containing either the circuit supply or the circuit load terminations, as covered in 110.14(C)(1).

Exception No. 3: Grounded conductors that are not connected to an overcurrent device shall be permitted to be sized at 100 percent of the calculated maximum current of 705.28(A).

(2) The maximum currents in 705.28(A) after the application of adjustment and correction factors in accordance with 310.14

(3) Where connected to feeders, if smaller than the feeder conductors, the ampacity as calculated in 240.21(B) based on the over-current device protecting the feeder

(C) Neutral Conductors.

Neutral conductors shall be permitted to be sized in accordance with either 705.28(C)(1) or (C)(2).

(1) Single-Phase Line-to-Neutral Power Sources.

Where not elsewhere required or permitted in this *Code*, the ampacity of a neutral conductor to which a single-phase line-to-neutral power source is connected shall not be smaller than the ampacity in 705.28(B).

(2) Neutral Conductor Used Solely for Instrumentation, Voltage, Detection, or Phase Detection.

A power production equipment neutral conductor used solely for instrumentation, voltage detection, or phase detection shall be permitted to be sized in accordance with 250.102.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 12:39:31 EDT 2021

Committee Statement

Committee Statement: This section has been revised to improve clarity. The requirements in new item (2) and (3) were previously located in Section 705.11(A) and 705.12 of the First Draft Report, however Section 705.28(A) is the location in Article 705 where circuit currents are determined so these requirements are moved here to improve the uniform application of this Code. This section has been reorganized into a list in keeping with the NEC Style Manual Section 3.3.2

The term “circuit” has been removed from subsection B to align this phrase with its definition.

Response Message: SR-8388-NFPA 70-2021

Public Comment No. 1050-NFPA 70-2021 [Section No. 705.28(A)]

Second Revision No. 8396-NFPA 70-2021 [Section No. 705.30(A)]

(A) Circuit and Equipment.

Power source output ~~circuit~~ conductors and equipment shall be provided with overcurrent protection. Circuits connected to more than one electrical source shall have overcurrent devices located to provide overcurrent protection from all sources.

Submitter Information Verification

Committee: NEC-P04
Submittal Date: Tue Oct 26 13:03:29 EDT 2021

Committee Statement

Committee Statement: The term “circuit” has been removed to align this phrase with its definition.
Response Message: SR-8396-NFPA 70-2021

Second Revision No. 8397-NFPA 70-2021 [Section No. 705.30(F)]

(F) ~~Power~~ Transformers.

The following apply to the installation of transformers:

(1) For the purpose of overcurrent protection, the primary side of transformers with sources on each side shall be the side connected to the largest source of available fault current.

(2) Transformer secondary conductors shall be protected in accordance with 240.21(C).

(2) ~~The requirements of 450.5(A)(2) shall not apply to transformers used solely as a neutral reference point for power source controls.~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 13:04:41 EDT 2021

Committee Statement

Committee Statement: The title of this section is changed to remove “power”, since there is no other location in this article where other transformers are covered. The modifier "Power" is an undefined term that does not add clarity.

List item 3 is deleted as being inadequate to ensure that these transformers are adequately protected from overcurrent, including faults. Furthermore, the use of the term “for power source controls” is not sufficiently defined, or restricted, to ensure that this exception to the general requirements in Article 450 would be applied uniformly across all users of this Code. If modifications are needed to the general rules in Article 450, the restrictions on the modifications, such as transformer types, sizes, locations, etc., must be clearly stated so as not to potentially cause a user of this Code confusion, that could result in an unsafe condition.

Response Message: SR-8397-NFPA 70-2021

Second Revision No. 8398-NFPA 70-2021 [Section No. 705.32]

705.32 Ground-Fault Protection.

Where ground-fault protection of equipment is installed ~~as~~ in ac circuits as required elsewhere in this *Code*, the output of interconnected power production equipment shall be connected to the supply side of the ground-fault protection equipment.

Exception: Connection of power production equipment shall be permitted to be made to the load side of ground-fault protection equipment where installed in accordance with 705.11 or where there is ground-fault protection for equipment from all ground-fault current sources.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 13:07:36 EDT 2021

Committee Statement

Committee Statement: While Article 705 applies to both ac interconnected power production sources and dc interconnected power production sources, the issue addressed in Section 705.32 has always been applied only to ac interconnections of power production sources. DC power production sources have ground fault protection requirements covered by requirements in other parts of the Code and specific listing requirements for the dc ground fault protection equipment (see 690.41 for one example). Applying the requirements in 705.32 to those dc circuits would likely conflict with the listing requirements of those products and possibly defeat the GFP functions within them.

Response Message: SR-8398-NFPA 70-2021

Public Comment No. 1976-NFPA 70-2021 [Section No. 705.32]

Second Revision No. 8399-NFPA 70-2021 [Section No. 705.40]

705.40 Loss of Primary Source.

The output of interactive electric power production equipment shall be automatically disconnected from all ungrounded conductors of the primary source when one or more of the phases of the primary source to which it is connected opens. The interactive electric power production equipment shall not be reconnected to the primary source until all the phases of the primary source to which it is connected are restored. This requirement shall not be applicable to electric power production equipment providing power to an emergency or legally required standby system.

Exception: A listed interactive inverter shall trip or shall be permitted to automatically cease exporting power when one or more of the phases of the interconnected primary 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 interconnected system once all phases of the 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 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 are typically required to limit exposure of power production sources to out-of-phase reconnection.

Informational Note No. 2: Induction-generating equipment connected on systems with significant capacitance can become self-excited upon loss of the primary source and experience severe overvoltage as a result.

Interactive power production equipment shall be permitted to operate in island mode to supply loads that have been disconnected from the electric utility or other electric power production and distribution network.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 13:09:03 EDT 2021

Committee Statement

Committee Statement: The word “interactive” was added to the first paragraph to align with the statement in the last paragraph and make it clear that only interactive equipment is required to meet this requirement.

Response Message: SR-8399-NFPA 70-2021

Public Comment No. 2029-NFPA 70-2021 [Section No. 705.40]

Second Revision No. 8401-NFPA 70-2021 [Section No. 705.46]

~~**705.46** Energy Management Systems (EMS).~~

~~Where a listed energy management system that controls multiple loads is connected to a feeder or service, a single value equal to the maximum ampere setpoint of the EMS shall be permitted to be used in load calculations for all loads controlled by the EMS where the following conditions are met:~~

(0) ~~The EMS shall include monitoring and controls that disconnect the managed loads upon loss of control by the EMS.~~

(0) ~~The access to settings of the EMS shall be restricted to qualified personnel in accordance with the requirements of 240.6(C).~~

(0) ~~The setpoint value of the EMS shall be considered a continuous load for the purposes of load calculations.~~

(0) ~~Loads not controlled by the EMS, connected to the same feeder or service as the EMS, shall be included in load calculations for that feeder or service.~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 13:12:57 EDT 2021

Committee Statement

Committee Statement: This section is removed to align with the relocation of common EMS requirements to 750.30 and to eliminate redundant requirements across the Code. Service and feeder load calculations based on an EMS are provided in 220.70.

Response Message: SR-8401-NFPA 70-2021

Public Comment No. 1044-NFPA 70-2021 [Section No. 705.46]

Second Revision No. 8403-NFPA 70-2021 [Section No. 705.50]

705.50 System Operation.

~~Microgrid~~ Interconnected microgrid systems shall be ~~interconnected to and~~ capable of operating in interactive mode with a primary source of power, or electric utility, or other electric power production and distribution network. Microgrid systems shall be permitted to disconnect from other sources and operate in island mode.

Informational Note No. 1: Microgrid systems often include a single source or a compatible interconnection of ~~mulitple~~ multiple sources such as engine generators, solar PV, wind, or ESS.

Informational Note No. 2: See Article 517 for health care facilities incorporating microgrids.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 13:34:14 EDT 2021

Committee Statement

Committee Statement: Though microgrids will most often include equipment suitable for the interconnection to other primary sources, such as interactive power production sources and control systems, the ability for a user of this Code to verify the “capability” of a microgrid to operate in interactive mode with another primary source is only practical where that microgrid is interconnected to that other primary source. It is impractical for an isolated microgrid, such as for a remote premises or campus, to be evaluated for this function without the presence of that utility or other primary power source. The term “capable” does not provide sufficient clarity for those applications since requirements for that specific interconnection would be unknown at the time of installation of the isolated microgrid. The continued allowance for the construction of isolated microgrids in this Code is imperative to the infrastructure of our communities and to provide security and resiliency from possible events.

A new Informational Note 2 notifies a user of this Code that, when planning a microgrid installation that supplies these facilities, they should consult any requirements in Article 517.

A correction for spelling is also included in Informational Note 1.

Response Message: SR-8403-NFPA 70-2021

Public Comment No. 1470-NFPA 70-2021 [Section No. 705.50]

Public Comment No. 2079-NFPA 70-2021 [Section No. 705.50]

Second Revision No. 8405-NFPA 70-2021 [Section No. 705.70]

705.70 Microgrid Interconnect Devices (MID).

Microgrid interconnect devices shall comply with the following:

(1) Be required for any connection between a microgrid system and a primary power source

(2) Be evaluated for the application and have a field label applied or be listed for the application

(3) Have ~~sufficient number of~~ overcurrent devices located to provide overcurrent protection from all sources

Informational Note: MID functionality is often incorporated in an interactive or multimode inverter, energy storage system, or similar device identified for interactive operation.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 13:40:55 EDT 2021

Committee Statement

Committee Statement: This editorial change is made to remove unenforceable language per NEC Style Manual Section 3.2.1.

Response Message: SR-8405-NFPA 70-2021

Second Revision No. 8406-NFPA 70-2021 [Section No. 705.75]

~~**705.75** DC Ground-Fault Detection.~~

~~In addition to the requirements of 250.167, functionally grounded power source output circuit conductors in microgrids operating at greater than 60 volts dc to ground shall have ground-fault detection that indicates that a fault has occurred. The ground-fault equipment shall be marked in accordance with 250.167(C).~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 13:42:58 EDT 2021

Committee Statement

Committee Statement: The section is deleted since DC ground-fault protection requirements for dc power sources are best addressed in the articles specific to the dc power production sources. There is also insufficient guidance in this section as to how to meet GFD requirements for dc sources since there are no limits stated, nor any standards that would generally apply to all dc sources. Different dc sources may require different performance requirements for GFP. For example, 690.41 contains grounding and protection requirements for PV dc circuits exist that require unique listing requirements for a PV power source. Section 250.167 also would apply without referencing that section in this article.

Response Message: SR-8406-NFPA 70-2021

Public Comment No. 1700-NFPA 70-2021 [Section No. 705.75]

Public Comment No. 1974-NFPA 70-2021 [Section No. 705.75]

Second Revision No. 8407-NFPA 70-2021 [Section No. 705.76]

705.76 Microgrid Control System (MCS).

Microgrid control systems shall comply with the following:

(1) Coordinate interaction between multiple power sources of similar or different types, manufacturers, and technologies (including energy storage)

(2) Be evaluated for the application and have a field label applied, or be listed ~~for the application~~ , or be designed under engineering supervision

(3) Monitor and control microgrid power production and power quality

(4) Monitor and control transitions with a primary source external to the microgrid

Informational Note: MID functionality is often incorporated in an interactive or multimode inverter, energy storage system, or similar device identified for interactive operation.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 13:47:34 EDT 2021

Committee Statement

Committee Statement: First revision text is changed to align this new requirement with the current state of the industry and available standards for listing.

Response Message: SR-8407-NFPA 70-2021

Public Comment No. 1825-NFPA 70-2021 [Section No. 705.76]

Public Comment No. 2169-NFPA 70-2021 [Section No. 705.76]

Second Revision No. 8408-NFPA 70-2021 [Section No. 705.80]

705.80 Power Source Capacity.

~~The sum of all sources capable of parallel operation in island mode shall have a capacity complying with 705.80(A), (B), or (C) in accordance with Article 220 or by another approved method~~ For interconnected power production sources that operate in island mode, capacity shall be calculated using the sum of all power source output maximum currents for the connected power production source .

~~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.~~

~~**(A)** Automatic Load Management.~~

~~Where load management is controlled automatically, the system shall have adequate capacity and rating sufficient to supply the maximum load that will be connected by the load management system at one period of time.~~

~~**(B)** Manual Load Management.~~

~~Where load management is controlled manually, the system shall have adequate capacity and rating for the supply of all equipment intended to be operated at one time. The user of the system shall be permitted to select the load connected to the system.~~

~~A permanent label shall be applied to the distribution equipment containing branch circuit overcurrent protection devices supplied by the system operating in island mode that states the total system capacity available to supply loads continuously and contains the following or equivalent wording:~~

~~NOTICE: Equipment is supplied by a power system incapable of operating all loads at one time. Manual disconnection of loads is required for system to operate independent of a utility source.~~

~~Informational Note: The opening of switches or circuit breakers to select loads is a common method of controlling loads manually.~~

~~**(C)** No Load Management.~~

~~When load management is not used, the source(s) shall have adequate capacity and rating equal to or greater than the full load that is operated when the system is in island mode.~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 13:52:53 EDT 2021

Committee Statement

Committee Statement: The capacity requirements for loads are found elsewhere in the Code and depend upon the type(s) of loads being served. This revised section text provides requirements on how to determine the power source capacity based on the aggregate sources present. The informational note is deleted since it does not add clarity and is not necessary to apply these requirements.

Response Message: SR-8408-NFPA 70-2021

Public Comment No. 1545-NFPA 70-2021 [Section No. 705.80]

Public Comment No. 34-NFPA 70-2021 [Section No. 705.80]

Public Comment No. 1049-NFPA 70-2021 [Section No. 705.80]

Second Revision No. 8409-NFPA 70-2021 [Section No. 705.81]

705.81 Voltage and Frequency Control.

Power sources operating in island mode shall be controlled so that ~~output~~ voltage and frequency ~~operate~~ are supplied within limits compatible with the connected loads.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 13:59:23 EDT 2021

Committee Statement

Committee Statement: First draft language has been edited to add clarity to the requirements in this section.

Response Message: SR-8409-NFPA 70-2021

Public Comment No. 2093-NFPA 70-2021 [Section No. 705.81]

Second Revision No. 8417-NFPA 70-2021 [Section No. 710.1]

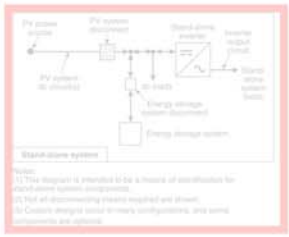
710.1 Scope.

This article covers electric power production systems that operate in island mode not connected to an electric utility or other electric power production and distribution network.

Informational Note: These systems operate independently from an electric utility and include isolated microgrid systems. Stand-alone systems often include a single or a compatible interconnection of sources such as engine generators, solar PV, wind, ESS, or batteries.

~~Informational Note No. 2: See Informational Note Figure 710.1.~~

~~**Figure Informational Note Figure 710.1 Identification of Stand-Alone System Components in a Common Configuration.**~~



Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 14:37:25 EDT 2021

Committee Statement

Committee Statement: Informational Note No. 2 and the new figure are removed as not necessary for the application of this article.

This figure could also cause confusion since these systems could be made up of a wide variety or architectures with many different types of equipment. Furthermore, the figure may imply to some Code users that for systems containing multiple interconnected sources, this article is all that applies when in fact, one would still need to apply article Article 705 where those sources are interconnected together.

Response Message: SR-8417-NFPA 70-2021

Public Comment No. 698-NFPA 70-2021 [Section No. 710.1]

Public Comment No. 1958-NFPA 70-2021 [Section No. 710.1]

Second Revision No. 8421-NFPA 70-2021 [Section No. 710.6]

710.6 Equipment Approval.

All power production equipment or systems shall be approved for use in island mode ~~use~~ in accordance with one of the following:

(1) Be listed ~~for the application~~

(2) Be evaluated for the application and have a field label applied

~~Informational Note: Stand-alone inverters operate in island mode. A multimode inverter will only operate in island mode if it is not connected to an electric utility supply. Inverters identified only for stand-alone applications are not evaluated for and are not intended for connection to export power in parallel with an electric utility.~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 14:46:30 EDT 2021

Committee Statement

Committee Statement: Editorial changes made to the first sentence add clarity when applying the requirements in this section. The phrase “for the application” is removed from Item (1) as redundant. The informational note is deleted as unnecessary to support or improve usability of the associated requirement per NEC Style Manual Section 3.1.3.

Response Message: SR-8421-NFPA 70-2021

Public Comment No. 1968-NFPA 70-2021 [Section No. 710.6]

Second Revision No. 8423-NFPA 70-2021 [Section No. 710.15(F)]

(F) Voltage and Frequency Control.

The stand-alone power sources shall be controlled during operation so that voltage and frequency ~~operate~~ are supplied within limits compatible with the connected loads.

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 14:51:02 EDT 2021

Committee Statement

Committee Statement: First draft language has been edited to add clarity to the requirements in this section.

Response Message: SR-8423-NFPA 70-2021

Public Comment No. 2086-NFPA 70-2021 [Section No. 710.15(F)]

Second Revision No. 8410-NFPA 70-2021 [Sections Part IV., 705.100, 705.101]

~~**Part IV.** Circuits Over 1000 Volts AC or 1500 Volts DC~~

~~**705.100** General.~~

~~**(A)** AC Power Source Output Circuits.~~

~~Circuits with a nominal voltage between conductors of over 1000 volts ac shall comply with the requirements in this *Code* applicable to installations rated over 1000 volts.~~

~~**(B)** DC Power Source Output Circuits.~~

~~Circuits with a maximum voltage between conductors of over 1500 volts dc shall comply with the requirements in this *Code* applicable to installations rated over 1500 volts dc.~~

~~**705.101** Wiring Methods.~~

~~All raceway and cable wiring methods for circuits covered by Part IV shall be installed according to the applicable Chapter 3 requirements. Other wiring systems and fittings specifically listed for use in microgrid or island systems and wiring as part of a listing system shall be permitted.~~

Submitter Information Verification

Committee: NEC-P04

Submittal Date: Tue Oct 26 14:02:36 EDT 2021

Committee Statement

Committee Statement: The language in this new section created in the First Draft were made prior to the resolution of changes to other articles including new Article 305. This section is no longer needed and is deleted as redundant.

Response Message: SR-8410-NFPA 70-2021

Public Comment No. 2081-NFPA 70-2021 [Section No. 705.100]

Public Comment No. 1702-NFPA 70-2021 [Sections Part IV., 705.100, 705.101]